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THE
ELECTRICAL REVIEW.

VOL. LXXXIV. MAY 9, 1919. No. 2,163.

ELECTRICAL REVIEW.

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OF SPECIFICATIONS.

WHEN several parties are considering the achievement of a certain aim, or result, it is more than probable that they will take various views of the most advantageous method of fulfilment. It often happens that the divergence of views on the means to be used causes more discussion and difficulty than the attainment of the result sought for.

It is the result which matters; and the result desired when electrical machinery is purchased can, in general, be stated in terms which satisfy every case. The object of the purchase of electrical machinery—probably of many other commodities also, but certainly of that one—is the provision of a reliable means of economically producing the maximum output of the product for which a market can be found.

It is, generally speaking, upon the means of securing reliability that the greatest differences of opinion are found, and the attainment of reliability supplies the chief reason why consulting engineers, supply undertakings, users of machinery, and electrical manufacturers, all go to work and prepare elaborate specifications showing what materials shall be used, and how they shall be used, in order to produce a given result. In addition to the attainment of the normal result, specifications frequently provide for the realisation of some other or abnormal result; and this second result may or may not be compatible with the first. A fruitful source of discrepancy in this respect is the question of temperature rise. The increase of temperature in an oil-cooled transformer has been known to be specified as 45° C. above the surrounding atmosphere after a continuous full-load run, as measured by a thermometer placed in the hottest part of the oil, while at the same time the specification asks that the increase of temperature above that of the ambient air shall not exceed 55° C. in the oil after a continuous overload of 50 per cent. A transformer which fulfils the second desideratum will run cool at normal rated output, while if it fulfils the first it will get too hot under the overload conditions mentioned. In such a case, what will the manufacturer do? He may quote on the generous transformer, or on the skimped one; or he may, possibly, offer alternatives. Probably some will do one thing, and others will do another, and comparison will be made on price alone, with the result that the cheap transformer will be bought, and overloaded until it gradually fries itself to death.

This is only one example, taken at haphazard out of many which might be adduced, of inconsistency in specifications. Such discrepancies as this arise from inadequate acquaintance with the machinery specified—from ignorance, in short, not necessarily culpable, but still ignorance.

Another and more objectionable class of specification is that issued by the consulting engineer or user who knows, or imagines he knows, all there is to be learned about electrical machinery. In this case the specification may easily extend to thirty or forty pages, bristling and scintillating with such efforts as:—

"The laminations shall be non-ageing, of high permeability, and low hysteresis loss.

"Insulating shields shall be placed between windings and between the core and adjacent windings.

"The coils shall be thoroughly dried.

"All insulators . . . shall be free from cracks and flaws.

"The tank . . . shall be oil tight."

And so on and so forth. The ridiculousness of such provisions can best be brought home by reversing them. "The laminations shall be of low permeability and high hysteresis loss; the coils shall be wet, the insulators flawed, and the tank as full of holes as a sieve."

Now, the British Engineering Standards Association has issued upwards of eighty standard specifications and reports. Among these may be found publications covering tramway rails, copper conductors, poles, telegraph material, insulation, conduits, lamps, meters, sparking plugs, instruments, electrical machinery, wall sockets, magnetos, &c. It may, therefore, reasonably be assumed that there is a possibility of being able to find among these publications a specification which will cover the machinery or apparatus required; and since this possibility exists, it becomes the duty of all parties interested to make the greatest possible use of these standard specifications.

Apparatus built in accordance with these specifications can be relied upon to give the results desired, and to be perfectly satisfactory in operation. This should satisfy the user's requirements.

There is, however, another and more important aspect of standardisation. Standardisation means the lessening of overhead charges, and the consequent cheapening of the finished product. Low selling prices tend to bring increase of business, and bulk of output again brings about reduction of overhead charges. Any factory, if it is to be profitably run, must produce as many articles as possible, of the smallest possible number of types. It is generally realised that it is standardisation, resulting in enormous production, that has made the Ford car so cheap. If Britain, now that the war is over, is to take the leading place in industry which is rightly hers, standardisation must be brought about to a far greater extent than ever before. And, since there is in existence an authoritative body grinding out standard specifications for every imaginable engineering product, it would not be a bad beginning if we availed ourselves of the fruits of its labours.

The National Industrial Council for the Electric Supply Industry.

The Council is at last an accomplished fact. The first meeting has been held. All parties met, and an auspiciously harmonious atmosphere prevails. So far, good. It only remains to start work in earnest. If the first year can be got through without dissonance, the Council can be reckoned an assured success. Everything appears to promise well, provided the spirit of the Whitley Reports be followed. We mention this because we understand that among the more legally-minded there is discussion as to the fixing of "plenary powers" for the delegates to the Council. The tone thus faintly adumbrates, perhaps, a conception of the Council as a ruling and mandatory body, a conception, it need hardly be said, alien to the spirit of the Reports. Whether or no we call it "Utopian," the underlying idea of the Councils is mutual agreement—and this, not merely between the two parties to the Council, but also between the individual constituents of each party. The tendency, perhaps, to conceive of the Council as a kind of quasi-legal Court which promulgates decisions from time to time is likely to be increased by the fact that, from the nature of the case, the National Council has to be formed first, in point of time, and afterwards the District Councils and the Works Committees. The National Council, however, when the scheme is in full working order, is the apex of a pyramidal organisation, of which each District Council and each Works Committee is an integral part. Moreover, the National Council is primarily representative in function, the essence of the constitution being that in the National Council the views common throughout the industry from each side respectively shall come up for adjustment and reconciliation, and thus lead to harmonious action being taken. It need hardly be said, therefore, that the first work of the National Council should be immediately to arrange for the constitution of the District Councils, and then for the co-ordination of the Works Committees under their respective District Councils. This, of course, is the machinery designed in the Whitley Reports, and success or failure must necessarily depend on the thoroughness and speed with which these constituent elements are formed and linked-up into an interdependent whole.

The Training of Disabled Men.

In past issues we have given special attention to the training of disabled fighting men in useful arts, and have been glad to publish particulars of methods which have been successfully adopted and occupations which fall within their scope. To-day we are pleased to give an account of the admirable work which is being done at the Croydon Central Polytechnic under the guidance of Mr. F. H. Taylor, as well as an interesting review of the results attained in the Glasgow Corporation Electricity Department, under Mr. W. W. Lackie and his meter superintendent (Mr. C. W. Marshall), by one of their pupils. Not only is the record of achievement most satisfactory, but also the high quality of the character and ability of the men is most encouraging, and we are glad to know that similar courses of training are in progress at many other centres. But very much remains to be done, and every facility should be given by the authorities and Committees concerned for the development of this good work. We are sorry to see that at one centre the way has been blocked for months by the failure of the Local Technical Advisory Committee set up by the Ministry of Labour to approve of the appointment of the Instructor, who was selected as long ago as September last, although the urgency of the matter has been pointed out many times. The inaction of this Committee is highly reprehensible.

Electroculture in Bondage.

It is a singular thing that directly a matter gets into the hands of a Government Department, it is immediately "hung up." We do not profess to have newly discovered this fact; it is, unfortunately, one with which we are all only too familiar—but it is remarkable with what regularity and consistency the phenomenon recurs, the only exceptions that we can call to mind being the demands of Trade Unions for more pay for less work, which are invariably granted with precipitation.

The example that we have in mind at the moment is the subject of electroculture. Various experimenters have been at work on this question for several years—some for many years—and their results, showing, on the whole, a strong preponderance in favour of the use of the electrical discharge, have been published freely from time to time. But in 1917 the Board of Agriculture decided to appoint an Advisory Committee to deal with the subject, and the Committee has laid its paralysing hand on the movement, with the expected result. We say "expected," because we predicted it.

In our issue of October 12th, 1917, we said: "It would appear to be too much to expect that a Department with a record such as that of the Board of Agriculture will not automatically follow established precedent, and in effect delay, instead of facilitating progress." "It should be understood that the results of its deliberations will be accessible to the public at any time, and that the Board's only interest is that of a Department of State paid by the public to receive and act on any recommendations made by the Committee." "We would ask whether it is not a fact that during the past year or so, public interest having been aroused, and the need for expert guidance having arisen, the Board's advisers—presumably with its concurrence—have obstructed rather than assisted the development of the movement."

The constitution of the Committee was announced in our issue of February 22nd, 1918; the curtain promptly fell, and no reports have been issued. Yet we have reason to believe that highly successful results were obtained last year under the ægis (or shall we say the "bushel") of the Committee, and a considerable sum of public money has been spent on the official experiments. The work of independent experimenters has been studiously ignored.

We maintain that (1) there is no justification whatever for concealment of the work done and the results obtained; (2) it is the duty of the Board to organise the research and to co-operate with independent workers, instead of giving them the cold shoulder; in this respect it should learn from the Department of Scientific and Industrial Research; (3) the only conceivable object of secrecy is to enable some person or persons to "acquire merit," as Kipling would say.

We are aware that it is the official view that the public should not be encouraged to adopt the system unless and until it is proved to be effective. This theory, if logically carried out, would put an effectual brake on progress. Where would the motor-car, the aeroplane, or even the electric lamp, have been now if such ideas had been allowed to delay their development? It is emphatically *not* the function of this Advisory Committee to block progress and experimentation until it shall have itself developed a commercially successful system of electro-culture—we want the results in this century. The quickest progress is made when the largest number of experimenters is at work, and if the Committee would organise and support research as widely as possible, and publish all the information available at once, it would be doing something really useful. At present it is simply blocking the way.

Super-station Efficiencies.

The Hydro-electric Power Commission of Ontario recently issued a Report on the rate of coal consumption in various electric generating stations in Canada and the United States. The Report resolves itself practically into a comparison of the coal-efficiencies of stations of varying size. It goes without saying, of course, that as the capacity of the station increases, the figures show an increasing efficiency. But the interesting fact emerges from the statistics collocated in the Report, that beyond a certain point the gain in economy due to size of station slackens off materially. A comparison was made between stations of 50,000 H.P. and 200,000 H.P. respectively; but although there was a saving in favour of the larger station of about 25 per cent., yet, taking into account the higher load factor, the Report concludes that "there is no doubt that if the smaller stations operated at the same load factor as that obtained in the larger station, the difference in the rates of coal consumption would be much smaller," and this "emphasises the fact that the very large stations do not tend to make very big reductions in rates of coal consumption, as compared with those of more moderate size." The Report goes on to say, *apropos* of the statistics, that "it is evident from these considerations that coal can be better conserved by appreciably increasing the load factors of existing stations of moderate size (around 50,000-KW. capacity), than by building huge stations having only slightly higher load factors than those of the smaller sizes."

There is also in the Report another point of super-power station interest. Commenting upon the curve of coal consumption for a station of about 150,000 H.P., it concludes that with the present station equipment, methods of operation, load factors, &c., the rate of coal consumption for large stations cannot come below about 6¼ tons per H.P.-year, no matter how large a station may be. Further, that "since the equipment now in use is getting near to the maximum possible efficiency, this means that probably under no circumstances will it be possible to get below, say, 5½ tons per H.P.-year. Centralisation on a vast scale may tend to reduce costs, but cannot conserve coal very much as compared with existing conditions in the large stations." (But the Report allows that as the coal bill is 40 to 60 per cent. of the total costs, even a small saving is a good deal of money.) How far these conclusions are felt to carry weight in England is a matter on which opinion is divided. Anyhow, the facts may at least perform the function that an irritating foreign substance does in the oyster—form a nucleus for discussion, around which some pearl of wisdom may develop.

SPECIALISED CONTROL.

By MAJOR E. A. PELLS, R.E.

America could, perhaps, be described as the home of specialisation, for it is not only on broad lines that they specialise, but they go even further and make studies of, and become particular experts in, some portion of the subject of which they are already specialists. This is, of course, all part and parcel of efficiency methods, and the idea of the sub-division of supervising duties, or the encouragement of specialisation amongst foremen and overseers, so as to obtain specialised control, is bound up in it. A good engineer is naturally efficient by reason of his general training, and would not think of putting a 100-H.P. prime mover on a 20-H.P. job, nor attempting to carry out a particular operation on a machine not designed for it, nor does he expect a machine to do more than it is designed to do. Therefore, it seems peculiar that he should require a man to carry out work that is obviously beyond his powers. The average shop foreman is expected to be a superman in the various traits he is expected to possess, satisfactorily to do all that is necessary in the successful management of a shop. As supermen are few and far between, some part of the job generally suffers, but by installing different men with definite qualifications for the various departments of management or foremanship, a high degree of efficiency can be obtained.

The first thing to be done is to relieve the workshop of all that might be termed pure brain work; then to divide the various duties of a shop foreman; and instead of there being, perhaps, four foremen in a shop, each governing his particular section, their sphere of authority is extended, but the scope of their work is limited to the particular function most suitable to their respective abilities and experience.

In this direction, F. W. Taylor advocated four types of foremen in the actual shop—namely, the "gang" foreman, who runs the gang, instructs, and generally directs operations; the "speed" foreman, whose sole job is seeing that correct speeds are maintained; the "inspecting" foreman, who is responsible for all work being up to quality and in order; the "repair" foreman, who is responsible for all maintenance work in connection with shop and machines.

In addition, it is necessary to have four foremen engaged in the planning room—namely, "the order of work and route clerk," whose duties are those of a planning and progress character; "the instruction-card clerk," responsible for all instruction cards, keeping them up to date as improvements in machinery and methods are made; the "time-and-cost clerk," who is responsible for all dealings with the operatives in such matters; and, finally, the "shop disciplinarian," who is practically the "liaison officer" between the functional foremen, and is responsible for all matters appertaining to discipline.

In works of a smaller character it may not be practicable to carry out the above arrangement, but some sound modification will be found to be far preferable to the old idea of a hustling driver. The "gang" foreman could easily be your champion operative, and as the greater part of his time will be taken up instructing the operatives and arranging the work so that the best method is always used, the "speed" foreman's duties would naturally be covered by him. He will automatically become a counsellor, and the workmen will seek his advice in all things affecting their work.

The "inspecting" and "repair" foremen might be combined, and the duties of "order of work and route clerk's" work could be taken up by the "instruction card" clerk, the "time and cost clerk's" work becoming part of the "shop disciplinarian's" duties. There must be kept in view always the fundamental idea that the actual workshop should be relieved of all brain work.

Any one of the above combinations could be made, irrespective of the others, or the manager might decide on some other modification, especially suitable to his particular industry.

To be a perfect shop foreman a man would have to possess the following qualities in correct proportions :—

1. Brains.
2. Education.
3. Technical knowledge and experience.
4. Tact.
5. Energy.
6. Grit.
7. Honesty.
8. Judgment.
9. Good health ; and
10. "Reliability" in all things.

All men are endowed with different proportions of the various qualities mentioned, and it is the art of management to get the right men into the right places. In choosing functional foremen it is unnecessary to look for all of these qualities in the men you select, so that with careful discrimination you stand a much better chance of getting the most diverse functions carried out in a satisfactory manner.

One result of putting in a system of specialised control based on these principles, is that you decentralise your productive efforts in the workshop, and centralise your control in the planning office, thus putting into effect the recognised axiom in the science of organisation to decentralise detailed activity and centralise control : it is the ability to discriminate exactly when to centralise and when to decentralise, which proves the born manager.

NON-CONDENSING ENGINES IN CENTRAL POWER STATIONS.

By T. WALMSLEY, Assoc.M.Inst.C.E.

Recent experience in connection with the industrial coal economy campaign, inaugurated by the Coal Controller's Department, has demonstrated to the writer that there exists a large field of usefulness for non-vacuum steam engines in industrial works where exhaust steam can be utilised for process work or the heating of buildings. Nor is this usefulness confined to manufacturing works. In central power stations there is still a place—albeit a small one—for the non-vacuum engine. Many medium-size power stations, particularly those that have converted from reciprocating to turbine plant, retain some of their old engines. These might be put to the useful and economical purpose of driving low-pressure generators for station auxiliaries, the exhaust steam being used to heat the condensate from the main turbines. The case of a high-pressure generating station supplying an auxiliary load of 10 per cent. of the total load, through a step-down transformer, will be considered. The steam consumption per kilowatt of a reciprocating engine, discharging at atmospheric pressure, will be taken as twice that of the main turbines. In practice, this figure will alter according to the size and type of steam-alternator units, steam pressure, and degree of superheat.

As the steam consumption curve for a turbine in the neighbourhood of full load is fairly flat, no great increase in the rate of steam consumption will be caused by reducing the load on the turbines in the ratio of 10:9, *i.e.*, by allowing the reciprocating set to take the station auxiliary load. Further, the increase in vacuum which usually accompanies a decrease in load will exercise a steadying effect upon the rate of steam consumption of the turbines. With the reciprocating engine taking load from the station transformers, the total steam requirements of turbines and engines may now be represented very approximately by $9 + 2 = 11$. Also the condensate from the turbine condenser together with the make-up water would be about five times the amount by weight of the steam supplied to the reciprocating engine. Taking the turbine average vacuum as 28 corrected to 30 in. barometer, the theoretical temperature of the condensate would be 100 deg. F. In practice, especially where Edwards air pumps and Parsons' augmentors are used, this figure would fall at least 20 deg. F. No great error will be made, therefore, in taking the average temperature of condensate and make-up as 80 deg. F. After passing through a feed-water heater, into which the exhaust from the auxiliary engine discharges, the temperature might be raised to 200 deg. F. Thus 5 lb. of condensate and make-up would absorb 600 B.Th.U. Taking steam at 200 lb. per sq. in. pressure, and 100 deg. F. superheat, and assuming 85 per cent. of the heat units in the admission steam to be discharged from the reciprocating engine, the latent heat per lb. of exhaust steam would be about 890 B.Th.U. Thus the whole of the latent heat in the discharge steam would not be absorbed by the turbine condensate and make-up.

If the reciprocating set is loaded to take 7 per cent. of the total load, the latent heat will then be absorbed. Further, the greater part of the sensible heat in the auxiliary engine exhaust would be conserved if, after filtering to remove oil, the water were returned to feed. Provided the return system were efficiently lagged, 80 per cent. of the heat units supplied to the auxiliary engine could be returned to the boilers. Thus, although the rate of steam consumption of the turbines is half that of the reciprocating engine, there would result a net saving of nearly 60 per cent. in heat units necessary for station auxiliaries.

Translated into fuel, this represents an economy of 4 per cent. of the total fuel consumption. A further advantage of heating the feed-water in the manner suggested is that the problem of supplying the economisers with water at a temperature of not less than 100 deg. F. is solved. On the debit side is the possibility of the economiser absorbing less heat from the flue gases, and the extra maintenance charges of reciprocating engines. These disadvantages will usually be compensated for by the improved water circulation in the boilers, which frequently results from a high feed temperature

The figures quoted in the foregoing article are necessarily approximate. They serve to demonstrate, however, that non-vacuum engines can often be used with advantage in central power stations.

The Muscle Shoals Nitrate Plant.—A most instructive view of the preparations made by the U.S. Government for the fixation of nitrogen on a large scale is given in the *Electrical World* of April 5th. Although the cessation of hostilities has put a temporary end to the need of nitrates for military purposes, their importance in agriculture is so great that, if the plant described can be operated as economically as the projectors have thought, they may be of very great value in times of peace. The installation was a rush job of the severest character, in which the ordinary routine of design and construction had to be abandoned in favour of doing everything in the least possible time. It is greatly to the credit of the engineers that this was accomplished without their being driven by necessity from sound lines of design. The power stations must be of high economy if they are to be useful in times of peace. The plant had to be erected and put in operation within a year, and to facilitate operations it was decided temporarily to take part of the power from the transmission system of the Alabama Power Co., which is capable of supplying about a third of the total output. The remainder is to come from the steam stations. A notable fact in respect to them is that while on January 1st of last year nothing but preliminary sketches had been made and none of the apparatus for the power plant purchased, eleven months later the cyanamide process had been started up with transmitted power, the first unit of the great turbine was practically ready for use, and two others under erection or ready for shipment, while the boiler plant was so far completed as to be ready when the turbine required steam. Whatever may be the ultimate fate of the plant under commercial stress in time of peace, its preparation for action in so short a time ranks as one of the big engineering feats of the war.

A MOBILE X-RAY PLANT.

In a paper read before the Roentgen Society, and published in the *Journal* of the Society in March, Mr. Howard C. Head described an automobile X-ray wagon by means of which it had been made possible to bring the X-ray apparatus quickly to a patient, instead of taking the latter to an establishment where the apparatus was installed. The horse-drawn wagons in use in Continental Armies before the war were cumbrous and inconvenient, and by the adoption of mechanical propulsion a great improvement was effected. The chassis of the Austin Motor Co. was found to be well adapted for the purpose, having a very low loading line—an important consideration, because the

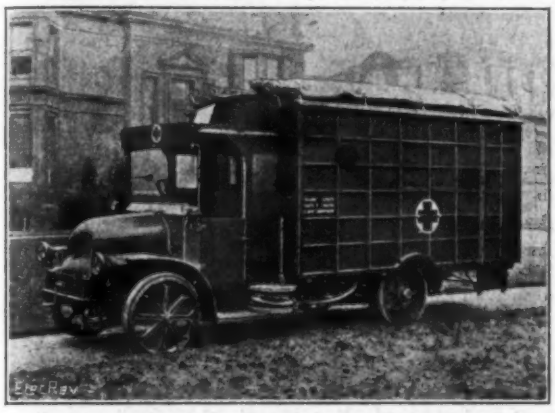


Fig. 1.—Mobile X-Ray Wagon.

induction coil and its fittings, the distribution switchboard, and the control board could all be manipulated from the car, the controls coming within the reach of a man of average height, while only one step was necessary instead of four or five as with an ordinary chassis; moreover, as all the weight was kept low, there was less tendency for such a car to overturn, even when at a considerable angle, and it was practically immune from side-slip.

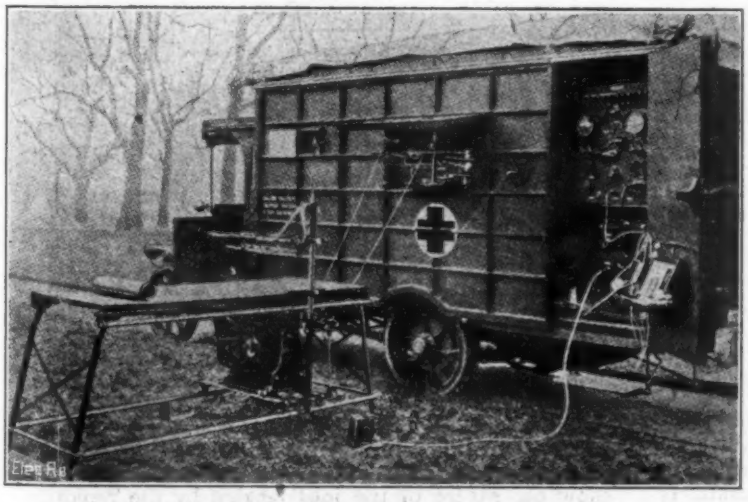


Fig. 2.—X-Ray Theatre (Without the Cover).

The model is a 2-3 ton chassis, fitted with a four-cylinder engine. The drive is distributed through substantial bevel wheels by a propeller shaft to each rear wheel. This special arrangement enables a light back axle to be provided, without any massive parts in the centre; such an axle will run on rough roads without the wheels losing contact with the ground, as the springs are not subject to reaction through the inertia of heavy central axle parts.

One of the first equipments produced with this type of chassis was built in July, 1915, and has since been in use near Paris. The present outfit (fig. 1) is fitted with a panelled teak body 12 ft. 9 in. long, 7 ft. wide, and 7 ft. high, and this is divided into two compartments—the photographic dark room and the room containing the X-ray apparatus. The photographic dark room measures 3 ft. 4 in. long by 7 ft. wide, and is practically a tabloid studio, fitted with every arrangement to facilitate the work. It is lead-lined on the side towards the portable X-ray theatre, to protect the plates, &c., from the radiation of the tube. Water is obtained from a 30-gallon storage tank underneath. A special safe-light is provided above the sink, with easily adjusted control for either daylight or electric light. An electrically-driven fan fitted to a special flue is provided to draw off tainted air from the room, fresh air being drawn in through special vents near the floor.

The apparatus room is 9 ft. long × 7 ft. wide, and the apparatus is so arranged in this room that radiography of the extremities can be carried out with a tube stand. Every piece of apparatus has a special fitting to which it is secured, so that, however rough the travelling may be, the apparatus cannot suffer.

The portable X-ray theatre (fig. 2) is 12 ft. 9 in. long × 10 ft. 6 in. deep × 9 ft. high at back and 6 ft. 8 in. high at front. A framework of poles and tie-rods is erected on the near side when the caravan is on the road, and these, together with the cover, are stored upon the roof. The canvas covering is of special material, three-ply, and so thick and close in texture that light and water are absolutely excluded. The theatre is lit by an electric lamp, which may be connected, if desired, to the foot switch. The material used for forming the cover of this tent is so efficient that X-ray work can be carried on inside even when there is brilliant sunshine outside.

The electrical generator, which is situated on the exhaust side of the engine, is driven by a Westinghouse Morse rocker chain coupled to the main shaft of the engine; it is designed to give an output of 20 amperes at 150 volts when the engine is running at 1,700 r.p.m. The rocker chain is disconnected when the car is running on the road, and is only connected when the generator is to be used

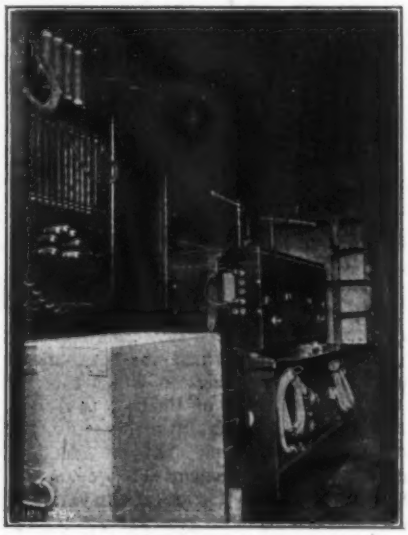


Fig. 3.—Interior of Apparatus Room.

either for charging the battery of accumulators or running the X-ray plant direct. When the engine is driving the generator the whole of the starting, running, and stopping can be carried out from the position of the main distribution board at the rear of the car. The generator is of light design, having a laminated field. It is provided with special protection against dust and dirt, and has a fan on the shaft for cooling purposes. The windings are protected by a condenser and lamp in parallel to

prevent high- frequency surgings from getting back to the machine.

A special battery of accumulators is fitted in two special cupboards at the back of the driver's cab, and the doors of these cupboards are fitted with louvres to ensure perfect ventilation; by this arrangement no acid fumes can enter the car, and the whole battery is most accessible, should it be necessary to give it attention. The battery is built up in special ebonite composition boxes. Each cell is fitted with a float to indicate the level of the electrolyte. The battery consists of 38 two-compartment 4-volt units, making 76 cells in all of the sealed-in type. The capacity of each cell is 80 ampere-hours (intermittent), or 10 amperes for 2½ hours, or 30 amperes for five minutes. Therefore, the X-ray operator is provided with a supply of energy capable of undertaking the quickest work and the most difficult cases, for he has at his command 20 amperes at 150 volts from his generator, 30 amperes at 150 volts for five minutes from his battery of accumulators, or 50 amperes at 150 volts when running with generator and accumulators in parallel.

As this outfit was for use at the Front, it was thought expedient to adopt in several instances, such as the couch, stereoscope, &c., the standard War Office equipment for field service, so that in case of necessity spares or renewals could be obtained locally.

Apart from this, the outfit is provided with a 16-in. spark intense discharge induction coil (fig. 3), built up in box form and fitted with a variable primary winding. The coil is mounted on a table on pneumatic buffers to provide against mechanical shock, and beneath the table are fitted a dipper mercury interrupter, a centrifugal mercury interrupter, and an electrolytic interrupter, together with the condenser, speed regulators, and a small interrupter selector switchboard.

In order that the coil may be operated without moving it into the portable X-ray theatre, a portion of the side of the car is made to hinge upwards, and a distribution shelf for the valve tubes, milliammeter, spark gap, and rheophores is attached, and connection is established to the X-ray couch. Next to the coil is the Coolidge control outfit fitted with a 12-volt accumulator of very large capacity. This battery also supplies current for the head, side, and tail lamps of the car through a switchboard mounted on the dash.

On the same side of the car at the end is the switchgear, consisting of a main distribution switchboard and a control switchboard for the primary circuit of the coil. The former is mounted on an iron pillar on which it rotates, so that it can be manipulated either from inside the car or from the portable theatre. In the latter case a door at the side of the car is opened, when both switchboards can face into the portable theatre with the Coolidge control to the left hand. All the apparatus remains and is used in the car. The only portions of the equipment that it is necessary to bring into the portable theatre are the couch, foot switch, and tube screen. On the opposite side of the room containing the apparatus is fitted the portable field service couch, a tube stand, and all the other necessary adjuncts for carrying out the best work.

At the end of the apparatus room are tube boxes in racks for the equipment, which includes, in addition to the Coolidge tube, six tungsten target tubes and three valve tubes. On the inside of the roof is fitted the stereoscope, which can be used inverted in this position, and in addition a small portable viewing box is provided.

As one of the functions of this type of plant is to provide a powerful apparatus for use in any temporary hospital, the plant has been so arranged that the minimum number of pieces of apparatus are carried into the building. It is only necessary to take the induction coil and its fittings, together with a trestle table which is carried on the door of the car, the couch, and the small control switchboard; all the other apparatus including the interrupters remain in the car, and connection is established from the car to the temporary X-ray room in the hospital by special cable, which is wound on cable drums mounted by the chauffeur's cab. One can, therefore, carry on radiography and radioscopy, and for that matter therapeutic treatment as well, in the car itself, in the portable X-ray theatre, or in any hospital or building.

The engine may be started by using the battery of accumulators for motoring the generator in the same way as a self-starter on a motor-car. There is no necessity to leave the portable X-ray theatre, or the vicinity of the switchboard, to start up the plant, to operate it, or to shut it down. A row of fuses on the top of the board controls the interior and tent lights and ventilating fans, as well as the motors of the mechanical interrupters, and these are all supplied with energy by the accumulators. In the case of the interrupters this is very important, in order that the speed may remain constant.

Beneath the automatic cut-out is a shunt regulator for regulating the output of the generator. A regulator is provided for controlling the lights of the interior of the car, and is situated underneath the row of fuses.

The connecting-up of the various parts of the apparatus is carried out by means of special cables. The induction coil and the foot switch are connected by their respective plugs to the sockets on the control board, and the foot switch and main switch on the control board are in parallel, so that either can be used irrespective of the other. There is a regulating resistance in series with the primary of the induction coil, and an ammeter. All the plug connections are made non-reversible, with the exception of one on the control board, and this is left reversible in order that the polarity of the primary and secondary circuits may be changed instantly if occasion requires.

The secondary or tube circuit is assembled by placing the high-tension distributing bracket in front of the coil, and connecting up the coil to the milliammeter, valve tube, and spark gap.

The couch is erected in the portable theatre, a tube inserted in the tube box and connected to the distributing bracket by the spring rheophores. If desirable, the three-ply wooden top of the couch can be removed, and an ordinary stretcher used in its place.

Such a mobile X-ray unit affords exactly similar facilities to those available in the base hospitals, and the possibilities of the utility of such a unit in normal times for mining districts, scattered areas, and so forth, are obvious.

METER REPAIRING AS A VOCATION FOR DISABLED SOLDIERS.

By A. CURRIE.

Now that so much attention is being directed to the subject of employment for ex-service men, a few notes by a disabled man may be of interest. The writer was the first disabled soldier to get employment in the instrument workshop, Glasgow Corporation Electricity Department, and consequently has seen the progress of the work in all its stages. The principal class of work is the repair of electrical meters of the mercury bath type, and this was described in some detail in an earlier article in the Electrical Review. It is now desired to give a few notes from the standpoint of the worker.

Technically, progress has been continuous, and it may be said that all the direct-current meters in Glasgow are repaired by disabled soldiers. The types in use in Glasgow are mostly C. & H., Ferranti, and B.T.H. A brief survey of the work done on a meter in the workshop and laboratory will show the nature of the jobs tackled by the repair "squad."

When brought in from circuit, after five years' service, each meter is tested on one or two loads, and its condition is generally noted. It is then dismantled and cleaned, and all defective parts are repaired or replaced; when every part has been gone over carefully, the meter is then re-assembled and tested for starting current. If found correct, it is put into its case, and is then ready for the test bench, where it is tested and calibrated. After each batch of meters has been put through the tests, the

individual meters are separated into groups according to their test performances. The first group are "passes," which, after undergoing a final examination, and having the constants entered on the ticket (which goes out with each meter), are sealed and put into stock, ready for consumers' premises. The others are subdivided into those that will pass by simple adjustments of the magnetic shunt or changing the ratio wheel, and those which are (*a*) magnetically, (*b*) mechanically defective. The man on duty in the laboratory attends to the first two groups. The meters which are magnetically defective are collected in batches and reflashed, whilst those that are mechanically defective are returned to the man who overhauled them, so that he may have an opportunity of preventing the repetition of any particular fault. By concentrating on inside work, the number of complaints from consumers has been greatly reduced.

We have a routine which we go through in turn, *i.e.*, one of us puts all the meters into their cases, which have been waiting for the meters to be cleaned; then in the following week he takes his turn in the laboratory, testing meters and carrying out adjustments that may be necessary; following that, he assists in changing ratio wheels and examining meters before passing them into stock, also making parts of instruments which are required at that period.

Through becoming familiar with the work in all its stages, the men take a keen interest in their occupation. Our chief (Mr. Lackie) and our superintendent (Mr. Marshall) induced the School Board to open one of their technical schools, which we attend at night, to be instructed in switchboard instruments and their construction, and also in the use of our tools, *e.g.*, files, lathe, vertical and other machinery necessary in the instrument-making trade. The teacher is supplied from our department, so that we have the advantage of being instructed in the work most common in the workshop. Our superintendent has been giving lectures and demonstrations weekly since we entered the employment of the Corporation, with the result that some of the disabled men are considered to have a very sound knowledge of the work. The meter tests here are much more accurate than they were when we entered the department; all meters which pass the usual tests have now to go through a lamp-load test (16 hours, dial reading). Meters must be mechanically perfect to pass this test, yet production has increased, a fact which proves that disabled men are fitted for this class of work.

All the men employed in this work have lost one of their limbs in the war.

National Electricity Supply in Australia.—In a reference to the appointment of the Electricity Commissioners, the Minister of Public Works stated that the commission would not act merely in an advisory capacity. The commissioners are to take over the whole administration of the Electric Light and Power Act, which covers all matters relating to electricity supply in Victoria. In addition to the preparation of a scheme for the establishment of electricity generating works at Morwell, the commissioners are also to inquire into and report on water power schemes. They are to investigate the means necessary to prevent further divergencies in systems of electricity and for standardising existing systems, and to make investigations as to the promotion and encouragement of the use of electricity. They have power to establish a State coal mine at Morwell and compulsorily acquire all land within a radius of 20 miles thereof, to prescribe conditions in leases of water rights for electricity generation, and to authorise the compulsory acquisition of easements over land by electricity undertakers. Power is given them to engage a secretarial and technical staff requisite for such an undertaking, and they will proceed to business without delay. In accordance with a promise made by the Premier, the total expenditure by the commissioners prior to the meeting of Parliament is not to exceed £20,000, but this will not prevent the energetic prosecution of the various duties imposed by the Act.—*Melbourne Age.*

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Safety Battery-Charging Device.

The author of the article on charging electric truck batteries which appeared in our issue of December 20th, 1918, has sent us the following particulars of a safety device which he has found useful in charging Edison batteries. He has often found that the temperature readings are neglected by the attendant in charge of the plant during boosting, especially in the night time, and has adopted a device which indicates to the attendant whenever the battery is receiving too high a supply of current; at the same time the device, which is automatic, reduces the charging current to a normal rate until the temperature of the electrolyte has dropped to a safe figure, after which the auto-cut-in remakes the circuit, giving the full boosting charge at which the switchgear is set.

The operation of the regulator is on the thermostatic principle; it consists of two flanged disks soldered together at the flanges so as to form a box or cavity. Inside the box there is a liquid consisting of ether or methylated spirits, which about half fills the cavity S (see fig. 1).

The vehicle battery has attached to one side or the top, whichever be most convenient, the disk arrangement above described, which may be tacked on with solder or fastened by means of a strap. Soldered to the disk is a bridge which carries two contacts C_1 and C_2 on insulators I, I_1, the contacts in turn being supported from two flat springs which can be adjusted by the thumb screw A S.

The standard charging plug and socket are shown at SCP, but on the outside of them an extra contact 1 is fixed.

The ordinary current-controlling resistance is shown at AR, and a combined relay and resistance at R and RA, &c.

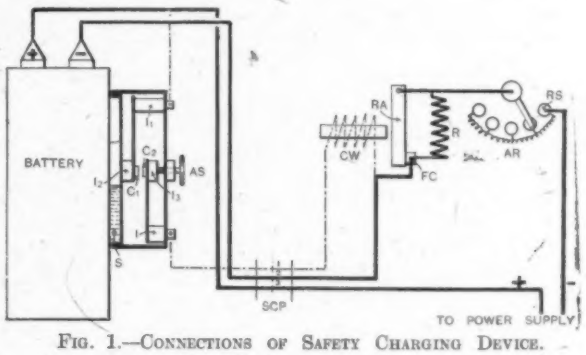


FIG. 1.—CONNECTIONS OF SAFETY CHARGING DEVICE.

During the process of charging the battery the current from the source of supply flows through the controlling resistance AR, contactor armature RA, contact FC, standard plug SCP, through the battery, and thence to the source of supply by way of SCP.

If the boosting current is high, and the electrolyte in the cell becomes heated, as the thermostat is in direct mechanical contact with the steel container, the heat is imparted to the solution of spirit (good all-round results are obtained with a mixture of 1 lb. of resin to 1 lb. of methylated spirit) which freely expands, causing the front portion of the box to belly out in accordance with the temperature obtained by the electrolyte. At a predetermined temperature which can be adjusted by the screw A S the contacts C_1 and C_2 touch one another, and the relay coil CW is energised, which attracts the armature RA, thus opening the contacts FC. The main charging current has now to flow through the resistance R, and is reduced to the normal rate until the temperature of the electrolyte has dropped to a safe figure, when the thermostat contacts are disconnected and CW allows RA to fall back to its original position short-circuiting R, thus raising the boosting current to the predetermined figure.

The contact 1 of the plug SCP is totally enclosed, and is of the "foolproof" type.

The Greene Electric-Steel Furnace.

The GREENE ELECTRIC FURNACE CO. is being incorporated at Seattle to build, sell, and install the type of furnace controlled by the Greene Process Metal Co., of St. Louis, says the *Electrical Review*, of Chicago. This furnace, designed and patented by Albert E. Greene, is the rolling cylinder, arc type. The 3-ton furnace installed in the plant of the Olympic Steel Works, Seattle, has two 5-in. graphite electrodes, requiring from 500 to 600 KW., two-phase, at a voltage of 100 to 110. The 3-ton charge of scrap steel is melted in two to three hours, this being deoxidised by means of the Greene slag process in which a patented composition of sand and clay, or lime, is used to give the required fluidity. This slag absorbes the oxide of iron carried into the bath on the scrap, eliminating it from the bath below. The oxide of

iron thus dissolved in the slag is reduced by throwing upon it finely powdered coke, ferro-silicon, or other reducing agent, resulting in the return to the bath of the iron formerly in the oxidised state. This elimination of the dissolved oxide from the molten mass obviates imperfect castings produced by blow-holes, which are caused by the presence of iron oxide. The company's newest type of 3-ton furnace has three electrodes, for three-phase current, and is equipped with a 400-K.V.A. transformer. Among other installations of this type made in Washington is a 2-ton single furnace in the new Aurora foundry, Seattle; a 1½-ton furnace at the plant of the Pacific Car & Foundry Co., at Renton; and furnaces of smaller capacity at Everett and Olympia. The first installation of a Greene electric furnace made in the Middle West was in the works of the Dayton Malleable Iron Works, Dayton, Ohio. The accompanying illustration (fi. 2) shows a Greene 3-ton electric furnace at the Olympic Steel Works, Seattle. The rolling mechanism affords easy control in tilting. The shell in this furnace is made of ¾ in. steel plate.

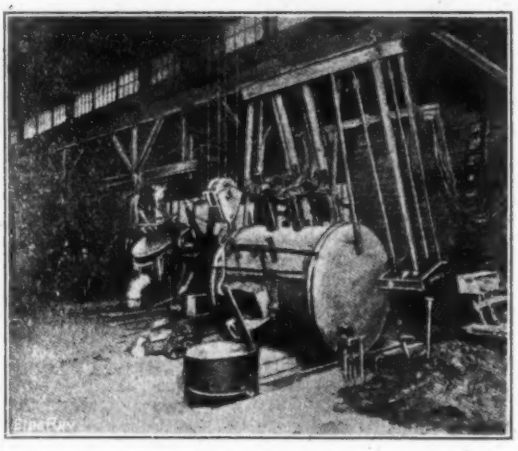


FIG. 2.—THREE-TON GREENE ELECTRIC FURNACE.

ELECTRICITY IN HORTICULTURE.

AT a meeting of the Lea Valley Growers' Association, held at Waltham Cross on April 23rd, Mr. E. S. SHOULTS opened a discussion on "Electric Working in Nurseries." The Association includes among its members practically all the fruit and flower growers along the valley from Tottenham to Hertford, a district famous for the production under glass of tomatoes, cucumbers, grapes, flowers, &c.

Mr. Shoults said that in the affairs of this world it was as important to have good reasons for not doing things as it was to know why things were done. Up to the present there had been a very good reason for the growers not using electricity, namely, that it was not there to use. In this respect the district was probably the most backward, considering its importance, of any place in the world.

The Council of the Association had recently approached the North Metropolitan Electrical Power Distribution Co. with a view to getting a supply for the whole valley, and it was to be hoped that the company was now interested in the subject. At present the company had mains fairly convenient for two groups of nurseries, at Brimsdown and at Freezywater. For the rest of the district there were many difficulties to be overcome.

The company, being a commercial concern, must first consider the interests of its shareholders, the interests of the community coming second. This being so, it had to be reasonably sure that the demand was likely to be sufficient to warrant the outlay on mains. High-pressure overhead mains offered the only economical scheme for distribution in such a district, and progress in this direction was stopped by the difficulty in obtaining wayleaves. It was to be hoped, however, that the legislation necessary for the removal of this obstacle would be secured before long.

The speaker contended that uses for electricity would crop up in all directions when once the supply was available. It was surely the business of the supply companies to do more to instruct the public in the benefits of electrical working; they could not expect possible users who knew nothing of the subject to do the pioneer work, or to take the risks inseparable from all enterprise.

In Germany co-operative working in agricultural communities had done much to help things forward; societies were formed, and they either put down power stations of their own, or by purchasing in bulk, or guaranteeing a certain consumption, they got the benefit of low rates that would be impossible to the ordinary small consumer. The enormous growth of such co-operation in Germany was indicated by the following figures.

Year.	1901.	1909.	1910.	1911.	1913.
No. of societies ...	1	82	257	240	650

Mr. Shoults briefly described the various systems of supply, and then proceeded to discuss the purposes to which electricity could be immediately applied in a modern nursery. At present the greatest amount of power required on a nursery was that employed for pumping purposes, and for this alone the electric motor would offer enormous advantages over the gas engine. The electric motor, consisting as it did of only one revolving part, in the place of the various reciprocating parts of the gas engine, required less expert attention, and occupied less space, particularly when the motor was direct coupled to the pump. Moreover, the motor was easily started, was provided with automatic lubrication, and required no cooling apparatus. Further, the motor could be automatically controlled by the water level in the tank, and this, coupled with the low cost for lubricating oil and spare parts, brought the cost of maintenance down to a minimum.

The power required to lift 20,000 gallons of water per hour 50 feet, allowing for an average efficiency for the pump, was 10 H.P., and taking electricity at 1½d. per unit, the total cost would be about 1s. 3d., which was roughly ¾d. per 1,000 gallons lifted 50 feet.

Another important purpose for which electric motors could be advantageously adopted would be for the driving of water circulators in the hot-water system. At present the circulation was effected by gravity and depended on the difference in temperature between flow and return, and the height of the mains above the heater; thus the forcing of fires did not necessarily improve the circulation. If electrically driven circulators were employed many advantages would accrue, such as the possibility of fixing boilers on the ground level, obtaining uniform temperature, and the ability to erect pipes where they were really required for heating considerations alone.

Other purposes in connection with which motors could with advantage be employed would be for stoke-hole pumps, spraying, chaff-cutting, soil screening, and fruit-grading machines, as well as in connection with trolleys and conveyors for the moving of fruit, soil, automatic stoking, &c.

The installation of electric light in a nursery would also be of inestimable value, not only for night work in the greenhouses, but also in the stoke-holes, sheds, and offices.

Dealing with uses for electricity that were likely to come when a supply was available for experimental purposes, the speaker mentioned, among others, the ventilation of greenhouses. At present the ventilating system of the greenhouses appeared feeble, and when the plants got up high there was no way of getting any real circulation of air amongst them. Electricity supplied the most convenient means of trying experiments on these lines. The amount of power required for this purpose would not be large, but from the point of view of the supply companies, it was only one of the many opportunities which would undoubtedly present themselves if a supply were available.

Another application which would probably come along would be power digging; here the problem was one for the grower, the implement designer and the electrical engineer to work out between them.

The adaptability of electric motors would appeal to all. They were readily portable and easily rigged up; thus there would be no necessity to have a separate motor for every purpose; a machine used for one purpose, say, in the summer would do for another in winter.

Amongst future possibilities one could mention such applications as the stimulation of growth by electroculture, the electrification of seeds, the sterilisation of soil and treatment of diseases, and the electrical heating of the houses. At present the latter did not appear practical, though it certainly offered enormous advantages. The capital outlay on its installation would be comparatively small, but the cost of running would be very much greater than that of the present system. Experiment was wanted in order to test whether the economies obtainable by the perfect regulation afforded by electricity, combined with the many other undoubted advantages were sufficient to compensate for the high cost per heat unit delivered.

Concluding, the speaker pointed out that most of the applications of science familiar to our use to-day had had their origin in the speculations of men bold enough to think and act along lines which seemed to the practical men of the times to lead nowhere.

A discussion followed, in the course of which Mr. A. H. BENNETT, resident engineer of the North Metropolitan Co., gave much useful information on technical points arising in respect of the connections which it was hoped might be made in the near future.

Mr. E. BARCLAY also gave some particulars of apparatus and photographs kindly lent by Messrs. Crompton & Co. for the occasion.

Electric Cooking on Trains.—According to the *Engineer*, the G.W. Railway Co.'s passenger guards' vans are being fitted with a gas-ring—or its equivalent, where the vans are lighted electrically—so that guards may warm their food.

THE TRAINING OF DISABLED MEN.

By FREDERICK H. TAYLOR, A.M.I.E.E., A.M.I.Mech.E.

(Abstract of paper read before the JUNIOR INSTITUTION OF ENGINEERS.*)*

THE training of the disabled man is a matter on which the greatest efforts, care, and thoroughness have been concentrated, with results which reflect credit on the State department concerned, and all those working in connection with it. Training is carried on in various branches of engineering, but probably a very much larger percentage of candidates apply for training in electrical engineering than in others. From evidence to hand it would appear that this fact is partly due to the impression prevailing in the minds of those who have to advise a man as to a trade to take up, that

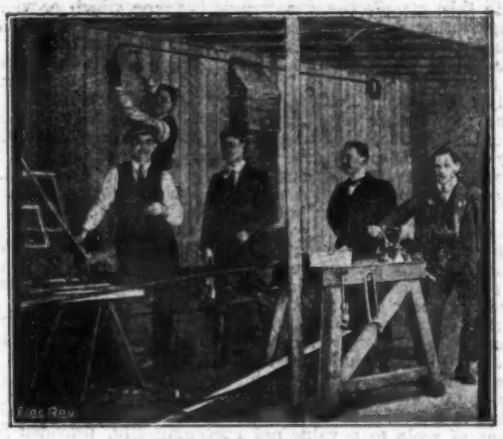


FIG. 1.

A group of disabled men at work. The man standing at the pipe-vice is a one-armed man screwing ¾ in. conduit.

electrical engineering is a "light occupation," and one which does not therefore call for any great physical exertion on the part of the trainee.

The men applying for training may be taken as representative of practically all trades and occupations. In many cases the ability of the trainee to grasp and develop the information imparted to him is beyond all expectation. In the case of a butler-valet, six months' training produced results as good as anyone could possibly wish for. The man was well able to plot curves of experimental results and make ready calculations in alternating-current work or similar subjects requiring clear, sustained mental effort. An exactly similar result was obtained with a man whose pre-war occupation was that of a farm labourer, and many records of similar results can readily be produced. Naturally the amount and nature of disablement is a factor in the case, but to nothing like the extent which might be supposed. A much more important factor is the care and method adopted in training.

The training must in every way be systematic; haphazard methods are utterly useless. The syllabus must be slowly, but surely, progressive, and carried on step by step. The utility and practical application of each section of the course of training should be made obvious to the trainee, so that his sympathy may be aroused and sustained. Whilst the practical side of the man's training must be a strong point, the theoretical side cannot be neglected, if a better type of worker than this country has had in the past is to be produced.

Approximately 24,000 men have been or are under training by the State in various subjects. Of these, approximately 3,550 have been or are being trained in various branches of engineering. With regard to electrical engineering, the number of men in training (or completed training) is approximately 882. Training is being carried out at approximately 45 centres, these being polytechnics or technical institutes, and in a few cases, the works of manufacturing electrical engineers. The training centres are well distributed over the whole of Great Britain. The disabled man does not necessarily become trained in his own home area, as it is frequently necessary to transfer him to some other locality, where the particular trade he requires is specially taught. In the event of such transfer the man has his travelling expenses paid, or a special grant towards the cost of living in the immediate vicinity of the training centre.

Treatment and training cannot usually be entirely divorced from one another, and in some cases the training may have to be regarded as, or may incidentally prove to be, a part of the treatment, that is to say, it may become more or less curative as regards the man's disablement. In many cases the trainee enters for his course within a few days of leaving hospital. It is most desirable that waiting for training should not occur. That the man's mind should lie fallow for two or three months or longer, as has often been the case, is indeed regrettable as tending to deterioration.

Friendly co-operation between men in the classes in many cases greatly relieves what would otherwise be a certain amount of lost time due to treatment.

In many cases training has unexpectedly proved to be an excellent means of diminishing disablement. This is a point which is not usually looked for, but is of immense value.

The disabled man is unfortunately often regarded by the employer as being someone so seriously handicapped as to render his services of considerably less value than those of the man who is physically sound; this view operates to the disadvantage of the disabled man, in many cases without any justification at all.

It is often suggested that a man with an artificial leg, or minus an arm or an eye, is too heavily handicapped to get level with another man not so injured, but one wants to observe what the man with such disablements can do in spite of them if he is to be properly appreciated, and if one is properly to assess his commercial value. Men with an artificial leg or foot show no hesitation, and very little loss of speed, in climbing a ladder or in walking to the extent that a man in the electrical trade is commonly required to

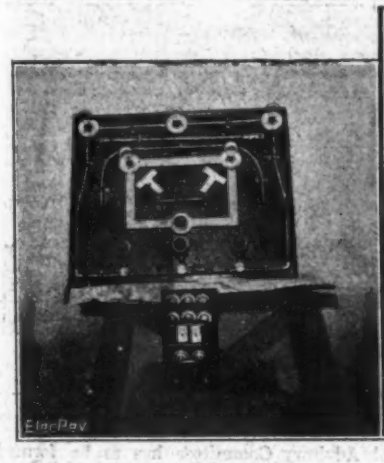


FIG. 2.

Exhibit shown at Ministry of Pensions' Exhibition in May, 1918. The items include screwed-steel pipe-work, a scarfed joint in ⅞-wire cable, wood-casing work, sweated joints, and a battery-charging board.

FIG. 3.

In the workshops at Croydon. The man on the steps is engaged on pipe-work on the roof timbers. His disablement is amputation of the leg.

FIG. 4.

In the workshops at Croydon. The man jointing 7/18 cable has suffered amputation of two fingers and thumb of left hand and thumb of right hand, and his left eye has been removed.

do. Standing, too, does not present any difficulty. Men with one arm only are capable of performing many ordinary duties quite efficiently.

I have, for example, instances of a one-armed man bending, cutting, and screwing pipe work quite as well as any other man. A man with amputation of two fingers and thumb on the left hand, and thumb on the right hand, holds tools quite comfortably, and is quite competent to make ordinary spliced joints in small cables, and in a reasonable time. A man whose right arm was amputated at the shoulder made a very good freehand drawing unaided and without an artificial limb.

During their training men are given an opportunity of trying all the ordinary duties carried out by others who have not their particular disablement, and it is as surprising as

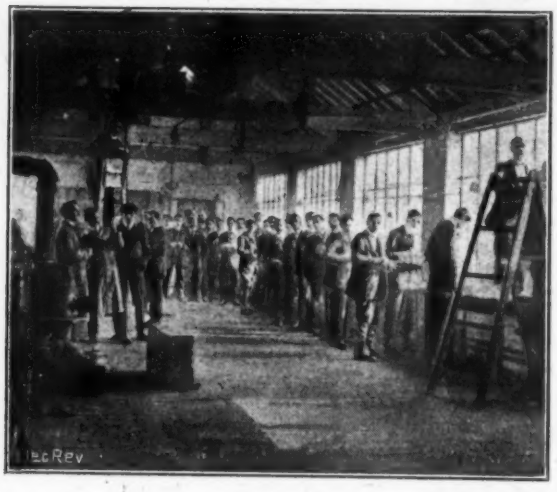


Fig. 5.

View of the workshop where installation and maintenance work is taught. The roof and walls are used for pipe-work and other wiring systems. A group on the left on arc lamp work.

it is satisfactory to note the ability which almost instinctively appears to be created in the man as a partial compensation for his deficiency.

The foregoing facts need to be carefully taken to heart by employers, as otherwise the disabled man is unnecessarily placed under a handicap in his chances of employment.

The branches of the industry in which training is being given at the various centres are:—

Electrical fitting.
Installation, maintenance, and repair work.
Sub-station and switchboard attendants.
Country-house plant attendants.
Armature winder.
Meter repairing.
Dynamo and motor construction.
Instrument making.
Testing and calibrating.
Switch and control gear manufacture.
Telegraphy and telephony.

At the training centre established at Croydon, initially for the three Home Counties, Kent, Surrey, and Sussex, specialisation has been made in electrical installation maintenance and repair work, although many men have been prepared for, and have taken up, central-station duty, sub-station duty, electrical instrument manufacturing, testing work, &c., private plant attendant's duty, &c.

This centre (Croydon) was opened on February 4th, 1918, and at the present time approximately 62 men are in attendance. The training provides as follows:—

(*a*) A lecture course covering elementary electrical engineering, supplemented by experimental laboratory work and experience in handling and running generators, motors, and switchboard equipment.

(*b*) A specialised course on installation maintenance and repair work, practically all the men enrolled being suitable for and taking up work under this branch of the electrical industry.

In order that instruction may be as complete as possible under section (*b*), a well-fitted workshop has been established adjacent to the main building, where every experience can be given to the men in the manifold details with which installation work is so replete.

The total number of hours that each man has to work is 30 per week, divided into 3½ hours in the morning and 2½ in the afternoon for five working days. Mostly, the morning is devoted to lecture work, laboratory and workshop practice being confined to afternoons. During the last two months of their course workshop practice may be extended to all day and every day.

The value of proper note-taking is carefully and persistently impressed upon the student. In the early days of this training centre, when classes were comparatively small in number, homework was set each day, and in almost every case was duly returned next morning fully worked out.

With the present fairly large numbers, home-work becomes impossible, and in its stead, test papers are set at fairly frequent intervals and worked out during class hours. The results are then analysed so that the instructors may know to what extent the subject matter of each question has been properly understood and remembered, and procedure arranged accordingly.

The success of work of this description very greatly depends upon the existence or otherwise of proper systems of recording the conduct and progress of each individual man, together with the fullest personal details concerning him; this involves much clerical labour, but the results are fully justified. Each man on being enrolled is handed an official training card, upon which are entered his weekly attendances and progress made, together with other particulars such as disablement and pre-war trade or occupation, &c. In addition to this, a more complete record is taken which provides amongst other points, for closer particulars as to the effects which the man has found to arise from his disablement.

A classification according to disablement is also made so that the man's ability for a given branch of his trade can readily be assessed. Personal notes, as to character, and other desirable points are also provided for. In this way, at the end of his course, the very fullest possible particulars are always at hand, so that the man can be placed out with a firm to the best possible advantage to each party concerned.

In carrying out his practical training in the workshop, each man is required to enter up, day by day, a note as to the work he has accomplished, the time occupied, and the results obtained, and to have it initialled as satisfactory or otherwise by the instructor in charge. The men are also required to take a certain part in looking after stock and materials, and in keeping their own workshops free from disorder.

During training the men are provided with note-books and stationery as necessary for training, and with overalls or shop-coats for their use whilst on duty in the workshops.

The man, having completed his training, and being ready for taking up an appointment, or alternatively continuing his training in a workshop or with a contracting firm, is allowed a grant of tools to a value not exceeding £10, provided he can show a certificate from his employer that such tools are necessary to the purpose. During his training, a portion of these tools may, if thought fit, be granted to him, in order to assist progress.

The work and duties of the Local War Pensions Committees are by no means of a negligible order. It is to his committee that the man is always invited to apply for information or assistance in almost every matter. All such matters as maintenance allowance, pensions, medical treatment, and so forth, common to the case of every disabled man, have to be dealt with by these bodies. The men whilst in training receive maintenance allowance, payable weekly by the local committee, and any cases involving special expenditure necessarily come under its purview.

Fig. 6.—"Are We Down-Hearted?"

A group of disabled men in the lecture-room. A reply to the question:—"Do you not find the men depressed and low-spirited?"

A local Technical Advisory Committee has to be formed to advise upon the more purely technical points which from time to time arise out of training.

The training is regarded by the men as filling a real want and offering them the chances, so richly deserved, of re-education, and a useful career in life. In the majority of cases, a letter of appreciation and thanks, for the training and help given, comes to hand from the man himself within a week or two of his being launched out into employment. None the less valuable are the complimentary letters to hand from the employers themselves. It is in very few cases that a man once having entered for training, withdraws, and such withdrawal commonly stamps him as being unsuitable, although such unsuitability perhaps has not been apparent.

In order that the views of trade unionism may receive appropriate consideration, the schemes of training in engineering subjects which have been drawn up are the result

of collaboration between the Ministry of Labour and the Ministry of Pensions. The National Trade Advisory Committee set up conjointly by these departments included representatives of the employers on the one hand and the workpeople on the other, the latter being nominated by the Electrical Trades Union.

With regard to the employers in the engineering trades generally, and in the electrical industry particularly, one feels that they should be very much better advised of what is being done in the way of training than would appear at present to be the case. It is hoped that the present paper may assist in that direction. It is the employer who can, by personal interest in and by constructive criticism of training courses in force, assist in making these more valuable from every point of view.

With regard to the absorption in industry of the trained disabled man, the present time is naturally one of some difficulty, but as conditions become more normal, it is hoped that the true value of the trained man will be justly appreciated.

In this country we issue appeals to employers to "find a job" for the disabled man. In France apparently a Bill has been passed guaranteeing the man compulsorily employment under the threat of special taxation for those who do not comply with this obligation.

The question has been raised as to the employer's position with regard to any increased liability in respect of insurance of the disabled man. My inquiries have elicited the information that any soldier or sailor, even if disabled and whether discharged or not, is included in the policy of insurance without any addition to the ordinary rate of premium for the particular trade concerned.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The E.P.E.A. Award.

Mr. R. Sidwell sincerely *hopes* that there are not many more undertakings situated similarly to that to which I belong.

May I reciprocate the sentiment, though I know of some? Still, our local committee tells us to *hope*, so we "Hope on, hope ever," dutifully month by month. We still hope; but whether hope will "spring eternal," one hardly knows. Let us hope so, for the sake of our dear friends the chief engineers, the Councils, and, last, but not least, our own executive committee.

Let us hope we never disturb their equanimity by insisting that *we* are going to *act*: and let us hope also that our treasurer will—'er, hope for our subscriptions to be paid; our esteemed secretary can also hope that the E.P.E.A.'s shadow will never grow less.

"Nil Desperandum," in to-day's issue (May 2nd) is absolutely right. From our chiefs, boards of directors, and Councils, we shall get nothing unless they *know* and are *shown*, that we can, and will, force justice if there is no other way.

Months and months ago, the "men" asked for certain concessions at the particular station from which I write. The Council told them they simply could not, and would not, grant such terms.

A week later notices for all hands were in, and two days before the notices expired, the *whole* of the men's demands were conceded, with *back money*. We, because we are not "men," are still hoping. In fact, "life's full of hope."

Connaught T. Smith.

May 2nd, 1919.

Telephone and Telegraph Line Construction.

I have read two letters on the above appearing in the ELECTRICAL REVIEW for April 18th and 25th, and am somewhat surprised to find that such erroneous ideas regarding the capabilities of the Post Office engineers exist. They are fully aware of the climatic differences between Bermuda and this country, and the sole reason for re-erecting a route broken down by a storm in the same manner is just this: there is no better way to rebuild it.

A moment's reflection will show that no comparison can reasonably be made between the lines of a power company and those of the Post Office; economical reasons at once forbid the erection of such heavy structures as are in use by the former for telegraphic or telephonic purposes, even assuming that it were practicable in all other ways.

As long as open wires exist they will more or less be subject to interruptions due to storms; you cannot build economically a route that will not be liable to a breakdown, given a storm of sufficient severity coupled with certain temperature and wind conditions well known to all telegraph engineers. The only remedy is underground cables, and in course of time all main routes will no doubt be equipped with cables.

Still, there will remain many places where open wires must be retained; to double or treble the existing charges, rates, and rentals on the ground that these additional charges are to cover the cost of placing all wires underground in order to avoid storm damage will not find favour with the public, who look at present to a reduction of charges rather than the reverse. Besides, even cables have been known to break down in fine weather, and they are relaid in the same way.

I feel sure that if "G.F.S." has a *suitable* method of constructing open routes which shall combine the qualities of solid construction, freedom from breakdown, storm or other, easy maintenance, electrical efficiency, and especially economical cost, better than the existing methods, which, by the way, are the outcome of many years of hard practical experience, he is sure of a sympathetic hearing from the postal authorities.

I fail to see why Mr. Broadbent should be astonished to find open wires to the coast on the Continental routes. All electrical engineers know the adverse effect that a length of high-capacity cable has on a telegraph, and especially a telephone, circuit. The engineers responsible for the building of these Continental wires merely reduced the capacity of the whole circuit to the lowest figure by running open wires of low capacity as near to the ends of the submarine cables as possible, which at that time was all that could be done to give commercial speech on the circuit. No doubt now, owing to the improvements made in "loading" cables, it would be possible to construct a loaded cable from, say, London to Paris, but considerations of cost must ultimately determine how far this method of construction may be carried out; the cost would be enormous, and the existing rates would hardly be adequate.

May I remark, in conclusion, that all the disadvantages that open lines would be subject to, as pointed out in the last paragraph of Mr. Broadbent's letter, were fully anticipated by the authorities responsible for the safety and efficient working of these circuits; to do them justice, they really have never been to sleep.

Thos. F. Barlow.

Blackburn, *April 28th*, 1919.

Referring to the remarks of "G.F.S." in your issue of April 18th, after any serious accident on a railway or in a mine, suggestions are put forward wholesale by people who have had nothing to do with railway work or mining, giving their ideas as to the best manner of preventing such occurrences. Your correspondent does not give us any information as to how he would prevent the breakdown of telegraph and telephone overhead lines by storms further than the *simple* remedy of putting them up suitably in the first instance.

For his information, I may say that the erection of Post Office wires in this country is not carried out by "rule of thumb," but is based upon engineering principles with definite factors of safety. The mileage of power companies' overhead lines in Great Britain as compared with the telegraph and telephone lines is exceedingly small; there is no comparison between the number of wires required, and, even so, power lines do break down during bad weather at times. It is practically impossible to guarantee any overhead line remaining intact through all conditions of weather, unless the line be built at an absolutely prohibitive cost.

It should be remembered, too, that a large number of the lines now under the maintenance of the Post Office Engineering Department was not erected by them, or to their specification, but was a legacy handed over to them prior to the war. Very great improvements have been carried out since then, and it is scarcely necessary to point out that a large percentage of the Post Office men have been engaged on other duties during the past five years.

I can bear witness to much work that has been done, and I am sure all Post Office engineers would be interested in reading what "G.F.S." would suggest should be put up to make a "suitable line" such as he refers to.

Telegraphs.

Hong-Kong Electric Supply.

In your issue of January 24th you did me the honour to publish a contribution, and I regret to notice either a misprint or a typist's error. On the top line of the second column of p. 92 there appears the statement, "In 1914 the Hong-Kong Electric Co. sold 614,750 units," but for "1914" please read "1904." I have referred to my draft MSS. and find "1904" there, but it is just possible that the copy sent to you was 1914, although I think not; anyhow, I am sorry for the mistake.

May I also add that on p. 117, top of second column, the paragraph: "But the management has been very unenterprising" is no reflection upon the British engineers at Canton who were the servants of the local company. The real difficulty was due—and probably still is due—to the Chinese who formed the "management."

My attention is also drawn to a misprint on p. 62, which reads, "the local quotation to-day in Hong-Kong is more than $120" (one hundred and twenty dollars); the figure in my MSS is $1,020 (one thousand and twenty dollars), which is the correct figure.

I am particularly sorry that any mistake occurred in connection with the Hong-Kong Electric Co., Ltd., because during the last three or four years all of the officials con-

nected with it have had a time of great worry and anxiety, which I feel sure will be lessened when their splendid new power station is at work in a few months' time. But I should like to take this opportunity to congratulate them all, especially Mr. Frank Graham, the manager, upon maintaining the supply in spite of great difficulties. They have given the Chinese of South China an excellent example of the good work invariably done by British electrical engineers.

The above mistakes were due to the impossibility of sending proofs to the author, but I hope that these explanations will remove any false impressions created by them.

C. A. Middleton Smith,
Taikoo Professor of Engineering,
University of Hong-Kong.

Hong-Kong, *March 25th*, 1919.

Crompton-Burgin Dynamos.

We are desirous of obtaining a specimen of a Crompton-Burgin generator, which type was last manufactured at these works in about 1886, and until a few years ago many of them were known to be still in operation. We have so far failed to secure one of these machines, and shall be very glad if you can assist us by inserting this letter in the next issue of your journal, in the hope that it may catch the eye of someone who owns a Burgin machine, or knows where one is installed. It is probable that a number of these machines have been scrapped during the war, and it would be a pity if at least a few of them, which are now historic, could not be saved from a similar fate.

Crompton & Co., Ltd.

Chelmsford, *May 2nd*, 1919.

Fault Localising.

I am pleased to note that two correspondents have kindly remarked upon my error regarding the Murray loop test. Although I was aware that the leads had an effect on the accuracy of the test, I was more concerned at that time with reducing the test to a simple formula than troubling over the percentage error introduced. While I agree with your correspondents, that their method of handling the difficulty (as far as home-made sets are concerned) is quite a good idea, as it is practically equivalent to connecting the cable under test direct to the bridge, yet it has not been my experience to run up against an instrument maker's bridge that is minus a few divisions at either end of the scale. I would suggest to your correspondents that makers usually overcome the difficulty by constructing the ratio arms of a high resistance in comparison with the resistance of the connecting leads.

Thus correcting for resistance of leads the usual formula—

$$x = \text{L } s/l \text{ becomes } x = \text{L } (a + y) \div (l + 2y)$$

where y = resistance of one lead.

Taking an actual case where the resistance of bridge = 20 ohms and resistance of lead $y = .01$ ohm, then taking Mr. Underwood's figures or $a/b = 2$, that is, a = one-third of the scale, the error represents 0.05 per cent. (approximate). In this case at 1/100 of the scale the error becomes 5 per cent., but I see no reason why the resistance of the ratio arms could not be considerably higher than the 20 ohms mentioned, in which case the percentage error along the whole scale would be brought within reasonable limits.

Of course the obvious remedy, when one knows that difficulty is experienced in localising a fault near the testing point, is to retest at the opposite end of the faulty line, where the fault will lie on the accurate position of the scale. While I am aware that home-made Murray loop sets are used with some success, I hardly think they bear comparison with instrument designers' types, for compactness and reliability, and makers that have specialised in Murray loop sets have overcome the difficulty connected with the lead resistance, without reducing the length of the scale.

H. Bujama.

London, N.W., *May 3rd*, 1919.

Trouble with Magnetos.

Your correspondent "Sparx" raises a point of interest which has often been discussed during the war. Extensive experimental work has been carried out with a view to determining the effect of different ignition systems on the power developed by internal-combustion engines, and as a result of these, I can assure your correspondent that there is no magic whatever in the name "Bosch."

A definite minimum voltage is required to cause a regular succession of sparks to pass across the electrodes of a plug in a cylinder containing an explosive gas at a given pressure and temperature, and the necessary qualification in a magneto is that it shall be capable of generating this voltage with certainty on the opening of the primary circuit, and at any speed at which it may be required to run.

In all good magnetos the secondary voltage, if permitted to do so, would rise far above this minimum figure, but in practice it does not do so, because when it reaches the breakdown voltage of the plug gap a discharge takes place, preventing the voltage from continuing to rise. If the plug is disconnected, the discharge then passes across the safety gap in the magneto itself.

A magneto required to ignite a high-compression engine should be capable of giving a regular succession of sparks across a 5.5-mm. 3-point gap or a ring gap consisting of a 1¼-mm. rod through a 7¼-mm. hole, in either case in air at atmospheric pressure and normal temperature. The regularity can best be tested on a M.L. rotating gap.

Any magnetos that can satisfy the above conditions will ignite any known lorry engine, and enable it to develop its full power. There are many makes of British-made magnetos which can do so as well as a "Bosch."

The trouble in your correspondent's case is probably due to one of the following causes:—

Sparking or incorrect setting of the contact-breaker.
Flashing-over or brush discharge at the safety gap or some internal point.
Leakage in the distributor, possibly due to carbon tracking.
Improper setting of the plug electrodes.
Defects in the wiring.

It would be interesting to see the diagram of connections of the dual system referred to, as possibly a leakage path may have been introduced when changing the magnetos owing to different terminal arrangements.

Alan Williams.

London, W.C., *May 5th*, 1919.

Searchlight Equipment and Operation.

I am obliged to Mr. Chapman for drawing my attention to what was, perhaps, a somewhat misleading phrase in my article on this subject. It is, of course, a fact that a small divergence is always present in a searchlight beam, and is in fact necessary, but this is, as Mr. Chapman mentions, only about 3 per cent., and it is usual in practice to include in the term "parallel" a beam having only this small and necessary divergence. The concentric rings do not, of course, cut off these very slightly diverging rays, but only the more widely diverging "cone of light" to which my remarks were really intended to refer. That this cone includes direct rays (from the negative carbon) is also true, but there is in addition a certain amount of reflection from the interior of the barrel, since some of the rays thrown on to the mirror are sufficiently divergent to strike that surface.

Hugh M. Goody.

London, S.W., *May 3rd*, 1919.

LEGAL.

Tramway Passenger's Claim Unsuccessful.

At the Leeds County Court, last week, Isaac Atkinson, a North-Eastern railway goods guard, claimed damages from the Leeds Corporation for injury received from a tramway trolley head, weighing over 7 lb., which came off on a car on which he was a passenger and struck him on the head. He was away from work for five weeks.

Mr. Clifford Bowling, for the plaintiff, contended there was negligence by the car being driven too quickly round a bend, and also that the trolley head was defective.

Joseph Bromley, assistant works superintendent at the tramway depot, produced the driver's report book, in which it was stated that two days before the accident the driver of the car had asked that the trolley head should be examined.

Joseph Lister said the night before the accident the trolley was examined and a new wheel put in, and the trolley was then in good order.

His Honour Judge Parfitt observed that there was no evidence that the car was driven at excessive speed. In view of Lister's evidence it was impossible to find that the defendants had been guilty of negligence. It should be publicly known that tramways were under no greater obligation to use reasonable care in the manipulation of their system than if it belonged to an individual. In his judgment the defendants had complied with the law that reasonable care must be taken to maintain the system in a condition of safety. The owners, whether a Corporation or private individuals, in no circumstances insured or guaranteed the perfect safety of the persons they carried; all they undertook to do was to use reasonable care. Judgment was given for defendants, but as plaintiff had sustained serious injury, the judgment was given without costs. The Corporation was exonerated from any sort of negligence.

Phelps v. Metropolitan Electric Supply Co., Ltd.

A claim for discount on electric energy supplied to four shops at High Holborn came before Mr. Justice Rowlatt in the King's Bench Division, on April 30th. The plaintiff was Mr. Thomas Phelps, of Northington, Overton, Hants., and the action was brought against the Metropolitan Electric Supply Co., Ltd. The claim was based on an agreement in writing dated October 31st, 1902, and was for a sum equivalent to a discount or allowance of 2d. per Board of Trade unit on the rate of charge made by the defendants for all electric energy

supplied to and consumed on the premises owned by the plaintiff in High Holborn, and also for an account of all electric energy supplied to and consumed on the premises from October 31st, 1902, to March 25th, 1918, and of the charges made by the defendants, and of the amount due to the plaintiff.

Mr. Rigby Swift, K.C., and Mr. C. E. Jones were for the plaintiff, and Mr. Barrington Ward, K.C., appeared on behalf of the defendants.

Mr. Phelps is the owner of extensive premises in Southampton Row and High Holborn, and his case was it was agreed on October 31st, 1902, that in consideration of his undertaking the responsibility for the payment for the whole of the electric energy supplied to the premises for a period of three years, a discount of 2d. per Board of Trade unit should be allowed, and the agreement was by mutual assent continued between the parties until March 25th, 1918. Throughout the period payment for the whole of the electric energy had been made by the plaintiff, or his tenants, but it was alleged with regard to the premises owned by the plaintiff in High Holborn that the defendants had not allowed the agreed or any discount in respect of the energy or current.

The defendants pleaded that the agreement applied only to the premises to which electric energy was supplied upon the responsibility of the plaintiff. They said that the plaintiff never undertook to be responsible for payment of the electric energy supplied to the premises in High Holborn, the electric energy being supplied to those premises under separate contracts with the tenants.

Evidence was submitted in support of the plaintiff's case, and evidence was then given for the defence that the shops belonging to the plaintiff in High Holborn were not included in the arrangement.

Mr. Barrington Ward, for the Metropolitan Electric Supply Co., Ltd., addressed his lordship, and pointed out that this was not an action for damages. It was an action for an account, and what his friend who represented the plaintiff had got to show was that these particular premises were included in the agreement of 1902.

His Lordship: Your point is this: that this document came into existence as an engagement by this gentleman to take electricity for the whole of his premises, and to pay for it, and to get discount on it, but as regards the four shops, although they were covered, they were only covered in a reversionary sense, because there were other people on the books.

Mr. Barrington Ward: With rights.

Proceeding, counsel asked his lordship to say that the plaintiff had not made out his case.

Mr. Rigby Swift, in reply, said in 1899, when Mr. Phelps made the original agreement, there was not a single shop which was under any agreement as to the taking of electric light. Each one of the shops might have gone to the Metropolitan Electric Supply Co., or to any other electric supply company. They were under no obligation to Mr. Phelps; they were under no obligation to the Metropolitan Co. When the Metropolitan Co. entered into their agreement with Mr. Phelps, and when he undertook to be responsible for the whole of the electric light which was to be brought on to his premises, he said that he was not going to have anything to do with the shops at the present time, but he expected if they supplied the shops, they would give him discount. They did not answer his letter; they went on bargaining with the shopkeepers as to supplying the shopkeepers with electricity. In May, 1902, he reminded them he had never had any answer. There was an interview, and it was said Mr. Phelps was told the company could not give him the shops in the contract, because they had agreements with the shopkeepers. Then the time came when there were some more buildings to be added, and when the old agreement was running out. In October, 1902, he insisted on having the shops, and the shops were then expressly included in the agreement. In the document it was deliberately stated that the supply was to be to all the premises of Mr. Phelps in High Holborn and Southampton Row where electrical energy was used. Counsel pointed out that the plaintiff had lost 12 years of the money which he otherwise would have had, because he did not bring his action twelve years ago, but he asked his lordship to say that the plaintiff was entitled to have the money for the last six years, and that amounted to £345 19s. If his friend who represented the defendants did not agree that that was the right figure, then he asked his lordship for an account in order that the right figure might be ascertained.

Mr. Justice Rowlatt said that the question was whether the plaintiff was entitled, and except so far as the Statute of Limitations interfered with him, had been entitled ever since 1902, to an allowance in the shape of discount or commission or rebate on the electric lighting bills of four shops in this building which he erected in 1899. When the building was first put up, there was an agreement which took the form of a request by Mr. Phelps to the defendants to supply the electric energy. The scheme of the document was that Mr. Phelps was the customer and the company were the suppliers. As a matter of fact, the real thing was that Mr. Phelps's tenants were the actual customers, and Mr. Phelps was the guarantor, that he collected their contributions and handed them in, and for that he got a commission. From that agreement all the shops were excluded. One could very well see that the company would be glad to deal with the shops direct. Mr. Phelps wanted the benefit of the discount and wrote a letter to the defendants. The defendants did not answer that letter, but they set to work to negotiate with the shops, and they got an agreement with the shops. He (the Judge) thought they might as well have written to Mr. Phelps. In 1902 the matter came up again, and another agreement was made in October, 1902, and that agreement was worded in a rather curious way. All exclusion of the shops disappeared. The document referred obviously to the whole of the premises. It was contended on behalf of the defendants that there was another consumer *de facto* on the books at the time with regard to the shops, and the document while applying to the whole of the premises, still had only a reversionary effect as regards the shops, because they were outstanding, and the immediate operation of the agreement was suspended as regards the shops. He had come to the conclusion that that was right, and that the defendants succeeded. It seemed to him that must be what the agreement meant on the facts of the case, and that view was confirmed by the fact that this claim was never raised for 16 years. In the circumstances, he should dismiss the action without costs.

Stobie v. Newcastle-upon-Tyne Electric Supply Co., Ltd.

In the Chancery Division, on Wednesday, April 30th, Mr. Justice Peterson had before him a dispute between Mr. Victor Stobie, steel manufacturer, of Sheffield, and the Newcastle-upon-Tyne Electric Supply Co., Ltd.

Mr. Upjohn, K.C., and Mr. J. G. Ward appeared for the plaintiff, and Mr. Frank Russell, K.C., Mr. Tomlin, K.C., and Mr. Livingston were for the defendant company.

Mr. Upjohn said that the point for the decision of the Court was whether or not upon the construction of certain agreements the defendant company was entitled to a share in the profits of Mr. Stobie's business and a certain control over that business. In 1913 Mr. Stobie, who was carrying on business in Sheffield as a steel manufacturer, had got a process of manufacturing steel in electrical furnaces, and was desirous of starting this business at Dunston, in Durham. For that purpose he wished to obtain land upon which to erect his buildings and plant. The defendant company had works at Dunston, and a surplus area of two acres where they were not working. This they leased to the plaintiff for a period of 15 years. The defendant company agreed to erect buildings for the plaintiff at his expense, the amount to be repaid with interest in five annual instalments. It was admitted that all these instalments had been paid. The next step was to get his plant. For that purpose an arrangement was made with the Industrial Plant Co., Ltd., which was guaranteed by the defendant company at a cost of £9,000 on the hire purchase system. That the Plant Co. had been fully paid by Mr. Stobie was admitted. The next thing they wanted was the electric current, and this was obtained from the County of Durham Electric Supply Co., which was a subsidiary company of the defendant company. Their accounts were also paid as they became due. Then working capital was required to provide which Mr. Stobie put in £2,400 and the defendant company agreed to provide £7,000 as it was wanted, which was to be repaid by instalments of principal and interest. As more money was wanted further advances were made, and here again it was admitted that every penny had been repaid by Mr. Stobie. In this state of things the defendant company claimed that they were entitled to a rent of £100 a year for the hire of the plant which Mr. Stobie had bought and paid for, a share in the profits of the business, and certain control over the business to secure payment of those profits. The case for Mr. Stobie was that every penny advanced having been paid off with interest he was entitled to the benefits of the business, free from any claim by the defendant company.

Counsel after having read the agreements between the parties, contended that they could not possibly mean that the defendant company was entitled to a share of profits in respect of the working capital or other advances which had been paid off. In the alternative, he submitted that the contracts were unconscionable, and should be set aside.

Mr. Tomlin, replying for the defendants, said that the real question was whether Mr. Stobie could get out of a bargain into which he had deliberately entered. The negotiations between the parties occupied over three years before the agreements in dispute were signed. Mr. Stobie had invented a new furnace for the production of steel with which he was anxious to experiment, but he had not got the money to do it. It was under these circumstances that he approached the defendant company. It was a speculative undertaking on their part, with the knowledge that if it failed nothing could be recovered from Mr. Stobie. On the construction of the documents counsel asked his lordship to say that the agreement with regard to profit sharing, &c., did not expire until the end of the lease, and that in the circumstances this was a perfectly fair and proper working arrangement.

His Lordship, after hearing argument as to the construction of the agreements between the parties, held that notwithstanding the fact that the moneys advanced by the defendant company had been repaid, the company was entitled to a share of the profits of the plaintiff's business for the term of the lease (15 years), and to a rent of £100 a year in respect of the plant.

The action was accordingly dismissed with costs, and the counterclaim of the defendants allowed.

Workmen's Compensation Case.

At Rugby County Court, last week, the case of F. H. Petch, labourer, whose hand was crushed in an accident, was brought forward. The particulars of claim stated that there was no written agreement or award, but weekly payments of £1 5s. had been made to the workman from the date of the accident. In the filed statement the B.T.H. Co. alleged that Petch had neglected or refused to continue proper medical treatment, that he had for some time past been capable of doing light work but had failed or neglected to obtain suitable employment. Respondent held that no benefit could be derived from continuing the medical treatment, that the condition of his injured hand rendered it entirely useless for work, and that no suitable work had been offered to him.

Mr. Willes, appearing for the B.T.H. Co., said that after application was made to diminish or terminate payments it was agreed that a lump sum of £115, with reasonable costs, would be a perfectly fair and adequate assessment of the workman's claim, but payments had been continued because it was felt by the employers to be fair.

In view of the agreement His Honour consented to the withdrawal of the application.

Atlantic Cable Lease.

In the Chancery Division before Mr. Justice Eve on May 2nd the Direct United States Cable Co., Ltd., moved for an injunction to restrain the Western Union Telegraph Co., Ltd., from giving, or acting upon, a notice purporting to determine a lease of a submarine cable between America and this country, which cable was leased by the plaintiffs in 1912 to the defendants for a long period at £58,500 per annum. The lease required plaintiffs to repair any breaks within a specified period, otherwise defendants could give notice to determine the lease. Owing to war conditions, however, a break which occurred in September, 1917, could not be repaired within the specified 18 months, and in March this year a summons was taken out by the plaintiffs claiming relief under the Courts (Emergency Powers) Act against defendants exercising their rights. The matter was reported at some length in the *Times* for May 3rd. The judge ultimately allowed the case to stand over on the defendants giving an undertaking that any notice to be served determining the agreement should not prejudice the rights of the plaintiffs under the Courts (Emergency Powers) Act, also that the notice of April 25th, 1919, given by the defendants determining the agreement should be suspended without prejudice to any question until the trial of the action.

Meharey *v.* Belfast Corporation.

On April 28th, in the Belfast Police Court, R. Meharey (trading as Porter Bros.) summoned the Belfast Corporation for failure to supply him with electricity for the use of motors on his premises from January 27th till February 15th, 1919, during the strike. Plaintiff's loss was estimated at £1,000, but he did not claim that sum. Evidence was given by the Town Clerk, the electrical engineer (Mr. Bloxham), and the Lord Mayor, as to the arrangements made with a view to maintaining the supply while the strike was in progress. For the Corporation it was stated that if plaintiff was successful the Corporation would be victimised by innumerable transactions, and there would be no end of it. The fault of the failure did not lie with the Corporation, but with the Strike Committee. It was submitted that the whole summons was misconceived and failed, and should be dismissed. For the plaintiff it was stated that there was no evidence of any attempt being made to get over the difficulty when the Corporation first received notice of the strike, and that all through the strike the Corporation were more or less passive. The Court will give its decision on May 12th.

Industrial Re-organisation.—The Executive Committe of the National Alliance of Employers and Employed, which consists of representatives of employers and trade unions, has had under consideration the proposals of the National Industrial Conference, and, as a result of its deliberations, has issued an agreed statement. The conclusions arrived at are summarised as follows:—

1. The acceptance of the proposals of the National Industrial Conference.
2. The importance of the necessary legislative action being taken by the Government without delay to give effect to the recommendations of the Conference.
3. The principle that the workers should have a direct share in the control and direction of industry on the understanding that there is to be full co-operation for industrial development.
4. The principle of annual holidays for all regular workers—the period and the financial provisions to be arranged according to the circumstances of each industry.
5. The desirability of supplementing joint organisation which is purely industrial in character by a system of Joint Area Boards on the lines indicated in the full statement.
6. The necessity for speeding up all machinery for negotiation and for decentralising the work of negotiation as far as possible.

BUSINESS NOTES.

Catalogues Wanted at Athens.—H.M. Consul-General at Athens reports that a catalogue library is being formed in connection with the Air Department of the Ministry of Marine, and that they would be glad to receive catalogues from British manufacturers. In the case of any catalogue of goods not used by the Air Department, it will be transmitted to the Ministry of the Greek Government, which may be more immediately concerned. Catalogues should be sent direct to Commander J. Weston, British Naval Mission, Director of Technical and Equipment Section, Royal Hellenic Naval Air Service, Ministry of Marine, Athens.—*Board of Trade Journal.*

Metallurgical Coke, Iron, Steel and Ironstone Orders.—The Ministry of Munitions has suspended as from May 1st the operation of the following orders:—

Steel Supplies (Metallurgical Coke, Iron, and Steel) Order, 1916.
Steel Supplies (Steel Hexagons, Rounds, and Squares) Amendment No. 1 Order, 1916.
Control of Steel Supplies Order, 1916.
Control of Steel Supplies (Steel Rods and Wire) Order, 1917.
Steel Supplies (Steel Scrap) Amendment No. 3 Order, 1917.
Steel Supplies (Metallurgical Coke) Amendment No. 4 Order, 1917.
Steel Supplies (Steel Plates, &c.) Amendment No. 5 Order, 1917.
Control of Steel Supplies (Amendment) Order, 1917.
Iron and Steel Scrap Disposal Order, 1918.
Cast Iron Scrap Order, 1918.

Contract Conditions at Sydney.—The Sydney, N.S.W., Municipal Council has decided that with regard to the question of the amendment by tenderers of general conditions and specifications on which tenders have been invited, by covering letter or otherwise, in future it be laid down that a tenderer must not submit additional conditions at the time of tendering, or deduct from or alter any of the conditions of tendering; and that the existing conditions of tendering, which allows such amendments, be altered by reverting to the clause dealing with this matter, as set out in the conditions in use previous to the adoption of the existing conditions, such clause providing: "The specification and general conditions having been approved of by Council will not be departed from in any particular, and any tender sent in must accept the same unconditionally. If any tender shall be made subject to any modification, addition, or alteration, such tender will not be considered in any way, and will be rejected."

Over-Zealous German Agents in Holland.—The Dutch newspapers are full of advertisements of German firms, in which all sorts of offers are made for the sale and purchase of goods, offers which, as a correspondent of the *Frankfurter Ztg.* says, are mere empty promises and by no means calculated to increase Dutch confidence in Germany's economic stability. The correspondent advises German merchants to take a leaf out of England's book and keep quiet for the present, until a favourable moment occurs in which to put their goods on the market.—*Frankfurter Ztg.*, March 21st.

British Manufacturers in Canada.—According to the *Times*, a Canadian Association of British Manufacturers has been established, with branches at Toronto and Montreal.

Alien Immigration.—The Minister of Labour states that, under Article 22B of the Aliens Restriction Order, "no employer may take steps to obtain the services of any alien resident abroad without the permission of the Minister of Labour, and subject to such conditions as the Minister may impose; and one of the general principles which govern the administration of the Order is that no alien should be admitted into the United Kingdom for the purpose of performing services for which suitable labour is available in this country."

Dinner-Hour Entertainments.—At the B.T.H. Rugby Works Canteen during the dinner-hour there are daily entertainments, arranged by Mr. G. A. Maley. These include vocal and instrumental solos, band pieces, &c.

Reconstruction.—No. 23 of the Ministry of Reconstruction series of grey pamphlets contains a survey of Public Health matters.

Excess Profits Duty.—The decision of the Chancellor of the Exchequer, announced in his Budget speech last week, to reduce the Excess Profits Duty to 40 per cent., has been received with great satisfaction by all interested in the stability and development of British industry. The National Union of Manufacturers thinks, however, that in certain cases the standard should have been raised, and the Committee of the Union has decided to press for time to be given in which to pay the duty by instalments. Further, it is considered that as many businesses could employ the money usefully for necessary extensions of their operations, firms should be allowed to keep their excess profits as a loan for repayment over a period of years.

Work Conditions in Birmingham.—A statement has been made by several of the Trade Unions in Birmingham as to the condition of unemployment. Regarding electrical workers, the Electrical Trades Union reports that there are very few of the members now claiming on the out-of-work funds, for private work, which has necessarily been at a standstill during the war, such as installations in business premises and shops that were being refitted, is now brisk.

Exports to the Left Bank of the Rhine.—No import permits, military or otherwise, are now required in connection with imports into the occupied area on the left bank of the Rhine.

Catalogues and Lists.—Messrs. Petters, Ltd., Yeovil, and Vickers-Petters, Ltd., Ipswich.—This combination of interests, of which some particulars have already been given here, has its general sales office for London and export at 73, Queen Victoria Street, London, E.C. 4. It has issued an illustrated circular (four pages) giving descriptive particulars and weights, &c., of Petter semi-Diesel oil engines, and details and prices of the Petter semi-portable Junior oil engine.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Folder giving table of prices, voltages, cap type, &c., of Osram Atmos type lamps.

Entertaining the Demobilised at Birmingham.—The male employés of the Birmingham Electric Supply Department number 750, and of these 233 joined the Forces. About 130 have been demobilised, and on Thursday last week they were entertained to dinner and welcomed on their return to the Corporation's service. Mr. R. A. Chattock, city electrical engineer, presided, and supporting him were the Lord Mayor (Sir David Brooks), Ald. Jephcott, M.P. (until recently chairman of the Electric Supply Committee), and Mr. Burman (Committee chairman). Mr. Chattock stated that 29 members of the Electrical Department had lost their lives, and it was proposed to provide a suitable memorial.

Birmingham Industrial Fair.—The official prospectus has now been issued of the British Industries Fair (Birmingham), which is to be held in Birmingham from February 23rd to March 5th. It is under the official organisation of the municipality and the Chamber of Commerce of the city, and has the approval and support of the Board of Trade. It is proposed that every available building in the city shall be utilised, and, if necessary, a series of kiosks and exhibition stands will be erected in the squares and main streets. The classification brings electric light fittings and other such devices, also cooking and heating appliances, into Class A (Group I). Other classes and groups include hardware, tools, instruments, tools, belting, small machine tools, motor cycles, and motor-car accessories, &c. The primary objects of the Fair are the maintenance and extension of British trade and the capture of foreign markets. Communications respecting space and other matters should be addressed to the General Manager, at the Chamber of Commerce, New Street, Birmingham.

South American Trade Commissioner.—The Federation of British Industries Overseas Trades Committee has appointed Mr. J. McKellan as its Commissioner for the East Coast of South America. The Commissionership for the first year will cost £5,000.

French Company.—La Société Union Française d'Electricité (U.F.E.) is the name of a new company which has lately been formed in Paris, with a capital of £40,000.

Catalogues Wanted.—The Central Electric Co., Triangle, Yeovil, invite manufacturers to send their catalogues or latest lists. Other requests for catalogues appear in "Trade Announcements" and in "Personal" column.

Association of Electric Lamp Manufacturers.—In the report published in our "Business Notices" last week (p. 503), of the registration as a limited liability company of the Electric Lamp Manufacturers' Association of Great Britain, the name of Mr. C. E. Hunter, managing director of the Edison Swan Electric Co., Ltd., should have appeared as a member of the Council of Management.

Trade Announcements.—The International Electric Co., Ltd., have transferred their works and offices to their new factory at Ashley Road, Tottenham, N. 17, where all communications should be sent. 'Phone No.: "Tottenham 132."

The Foster Engineering Co., Ltd., of Wimbledon, ask us to state that their agents (Messrs. Hall, Scott & Co., of 9, Linenhall Street, Belfast) ceased to represent them on May 1st.

Mr. Arthur G. Foulds having become a partner in the firm of Hamilton Bros., 187, St. Vincent Street, Glasgow, the name of the firm has been changed to Hamilton, Foulds & Co. (incorporating Hamilton Bros.). The business will be continued as heretofore at the same address. In view of the increasing demand for their "W.H." direct-current motor starters, which have now been on the market for 15 years, they have taken over new premises at 23, Douglas Street, Glasgow.

The B.E. Co. (of London and Birmingham), Ltd., have removed their London offices and stores to Hendon House, 57, Upper Thames Street, London, E.C. 4. New telephone No.: "City 4047."

Mr. Herbert Senior has commenced business as an electrical engineer at Littlemoor Road, Mirfield, Yorks.

The Institute of Cost Accountants, Ltd. (by guarantee), has removed to 17, Victoria Street, London, S.W. Telephone: "Victoria 530."

The Thanet Electric Co., Ltd., has been registered to carry on business as electrical engineers and suppliers of electrical materials at 262, Northdown Road, Margate. Mr. Chas. Lill, who has recently relinquished his Commission in the R.A.F., has been appointed engineer and manager, and he invites the trade generally to forward latest catalogues, prices, &c.

The Cray Laboratory, Sugar House Lane, Southampton, have made arrangements to establish an Electrical Contracting Department, under the management of Capt. J. Young, A.M.I.E.E. (late R.E. and R.A.F.). Manufacturers and agents are invited to forward catalogues dealing with lighting, heating and power equipment for houses, works, marine craft and motor-cars.

Mr. H. A. Pearson, A.M.I.E.E., who represents Messrs. Allen West & Co., Ltd., and the Reason Manufacturing Co., Ltd., in London and the South of England, has changed his address from 139, Fenchurch Street, E.C., to No. 10, Bush Lane, Cannon Street, E.C. 4, where his telephone number is "City 7493."

Rathenau on Communism.—Writing in the *Times* on Tuesday, on the attitude of the Germans in Berlin to-day, "Viator" says:—"Such men as Hugo Stinnes, the coal magnate, also Dr. Walter Rathenau, of the A.E.G., have already offered their establishments to the Communists on the promise of personal immunity for themselves and families. These men argue that after a few months of Communism they will be called back to take charge as the only men capable of managing affairs, and that they will come back on their own terms."

Electrical Wages at Southampton.—According to the *Daily Herald*, electricians at Southampton intend making a big effort to bring their rate of wages up to the same standard as that of the electricians throughout the United Kingdom, and also to obtain "dirty money" for ship repairs. Wages are about 6s. a week lower than in other ports, apart from the absence of "dirty money."

Wages Regulation.—In the House of Commons, on Monday, the Wages (Temporary Regulation) Extension Bill was read a second time. It provides for an extension for six months of the wages regulation provisions which, passed in November last, come to an end on May 21st. Wages will therefore be stabilised until November 21st next. Sir R. Horne, in introducing the measure, said that the Government was thus carrying out the suggestion of the leading employers and employed. Nothing dislocated industry so much as uncertainty. It was important that the great industries should know where they were, and that wages must continue on the present basis in figuring out their new contracts.

Dissolutions and Liquidations.—A. Vernon Ward (Consolidated), Ltd.—Winding up voluntarily. Liquidator, Mr. G. Gradon, 15, 16 and 17, Eldon Street, E.C.

Baxter Manufacturing Co., merchants of electric lamps and electric lighting accessories, 23, King Street, Manchester.—Mr. M. Wilson and Mr. M. Hacker have dissolved partnership.

A. A. Carpenter, electrical engineers, 4 and 5, Masons Avenue, London, E.C.—Mr. C. A. Carpenter, Mr. E. Chown, and Mr. J. G. Beirri have dissolved partnership so far as regards Mr. E. Chown.

Geo. Schultz & Co., Ltd., 10, Arthur Street, London.—Winding up voluntarily. Mr. W. A. Scott, 50, Cannon Street, E.C., liquidator. Meeting of creditors, May 9th.

Book Notices.—The Library Press announces for publication shortly a new "Universal Wages Calculator," for the use of all trades where wages are paid by the hour.

"Jane's Pocket Aeronautical Dictionary." 64 pp. + 4 figs. London: Sampson Low, Marston & Co. Price 1s. 6d.

Messrs. Siemens in Australia.—According to the *Industrial Australian and Mining Standard*, the Sydney Municipal Council has now reversed its decision of October 22nd, 1918, and has placed Messrs. Siemens Bros. on its list of tenderers. Their tenders will now receive the same consideration as offers from other British firms.

Bankruptcy Proceedings.—*Re* L. A. Thomson (trading as Saville & Walton), late of 59, Victoria Street, Westminster, electrical engineer.—The application of this bankrupt for an order of discharge, was again before Mr. Registrar Mellor, at the London Bankruptcy Court on May 6th. He failed in November, 1915, with ranking liabilities £2,922, and assets that have realised £6. Mr. J. B. Knight, Official Receiver, reported that the application stood adjourned to give the bankrupt an opportunity to make an offer for the benefit of the creditors. A letter had been received offering to submit to a judgment for £40, and enclosing £20 on account, the balance to be lodged on or before June 8th. His Honour further adjourned the hearing until June 17th to enable the balance to be lodged in Court.

Non-Ferrous Metal Industry Act.—Additions to the list of licences granted under this Act appear in the *London Gazette* for May 6th.

LIGHTING AND POWER NOTES.

Aberayron (Cardiganshire).—Proposed E.L. Scheme.—It is proposed that the U.D.C. should adopt an E.L. scheme and utilise the water power available for generating electricity.

Accrington.—Proposed New Plant.—The electrical engineer has been instructed to report as to the desirability of establishing a new sub-station and laying down additional high-tension cables to cope with the present and prospective supply of electricity to the Church area.

Ascot.—Price Increase.—Under sanction from the B. of T., the Gas and Electricity Co. has advanced the price of electricity to 9d. per unit, as from the reading of meters at Lady Day.

Batley.—Cable Extensions.—In 1915 the L.G.B. sanctioned the borrowing by the T.C. of £4,118 for cable extensions in the Healey, Staincliffe, and Halifax Road districts, and application is now being made to the Board for permission to proceed with the works without further delay.

Blackburn.—New Generating Station.—The T.C. has approved a resolution to borrow £250,000 for the erection of a new generating station at Whitebirk. It was intimated that the Blackburn undertaking would form part of the Government electrical scheme, and that the new station would be erected to coincide with that scheme. It was mentioned by one member that the Government proposed to establish an extensive generating station near the docks at Preston.

Burnley.—Proposed New Works.—The Electricity Committee has been in communication with one of the leading consulting engineers with a view to preparing a scheme for submission to the L.G.B. to obtain power for the erection of new works to cope with the rapidly increasing demands.

Continental.—Norway.—The local authorities of South Trondhjem are to consider a Bill for the distribution of electricity in the country. It is proposed to build hydro-electric works costing in all £2,800,000 to be completed in four years. The country will be divided into six districts each having its own power station.

Spain.—A concession has recently been granted to the Sociedad Electrica Aguera to put down plant to utilise the water power of the River Chirla at Guriezo (Province of Santander), for the generation of electricity for lighting and power purposes.

Cork.—Price Increase.—The Cork Harbour Board has been notified by the Cork Electric Tramways and Lighting Co. of its intention to increase the price of electricity for power purposes by 15 per cent. This is the third increase since the outbreak of war.

Dorking.—Minimum Charges.—The U.D.C. has passed a resolution protesting against Messrs. Edmundson putting in force the minimum prices Act for electricity, under which the minimum payment per quarter is to be 13s. 4d.

Dundee.—Extensions.—The electrical engineer has issued a report regarding the proposed extensions for which the Secretary for Scotland is to be asked to grant borrowing powers. It is proposed to install in the present turbine house two 5,000-kw. turbo-alternators to run at a speed of 3,000 r.p.m., with condensers and auxiliary plant. Additional steam boilers will also be required. Owing to the exigencies of the war, no extensions were allowed to the existing system except a certain necessary amount of cable work, with the result that the margin of reserve, particularly of boiler plant, had been seriously encroached upon. The demands show no signs of abating. The present scheme will only meet the immediate requirements of the district. It is felt that there are good grounds for considering the possible water-power schemes in connection with Dundee if the Government could assist during the earlier stages.

Dublin.—May-Day Stoppage.—On a complete stoppage of work in this area on May 1st, in celebration of Labour Day, the Corporation power station at the Pigeon House ran as on Sundays, so that no electric power supply was available for carrying on industries, but electricity for household and street lighting was supplied. The tramway system was suspended for the day.

Ealing.—Fire.—A fire occurred early on Friday morning, last week, at the electricity department's generating station at Dean Gardens. Part of the plant had become ignited owing to overheating, but the fire was quickly suppressed.

Folkestone.—Proposed Price Increase.—At a meeting of the T.C., a letter from the Folkestone Electricity Co. was read regarding its intention to increase the price of electricity from 7d. to 8d. per unit, and stating that if the Council still withheld its sanction it would have to take steps to enforce its decision. The town clerk explained that there was a contract between the Council and the company that the latter should not be allowed to charge more than 7d. per unit.

Fuel Control.—The whole question of the control of coal is being investigated by the B. of T. The Coal Controller is considering the modification of fuel control, so far as electricity and gas supplies are concerned. It is expected that the control will be continued for at least another year, but on July 1st certain modification in regard to gas, electric heating, and coal will be introduced.

The present Order expires in June next.

The B. of T. notifies that it does not now consider it necessary to limit the discretion of local authorities in regard to the consumption of gas and electricity for public lighting.

Halifax.—Yorks. Centre I.M.E.A.—The Electricity Sub-Committee has consented to the electrical engineer acting as secretary and treasurer to the Yorks. Centre I.M.E.A.

New Cables.—The B.C. is recommended to authorise the expenditure of £4,604 for about 1,620 yards of D.C. feeder cable and pilot cable from the Electricity Works to Heath Junction. The Sub-Committee has authorised mains extensions, costing £255, including one to Salterhebble U.M. Chapel, subject to agreements as to part payments.

Loan Application.—The Committee has decided to apply to the L.G.B. for sanction to borrow £3,000 for electric motors, £3,000 for transformers, and £10,000 for mains.

Hatfield.—Proposed E.L. Supply.—The R.D.C. has ascertained that in the district only nine persons and firms out of 44 have written to desire a supply of electricity for power and lighting. The Council has decided to forward particulars to the North Metropolitan E.L. Co., who had been asked to extend their mains to the district.

Hastings.—Proposed Loan.—The T.C. has applied for a loan of £13,719 for new work in connection with the E.L. undertaking, and £5,000 for mains.

Heywood.—Year's Working.—The Corporation Electricity Committee reports a loss for the past year of £290, as against a loss of £741 the previous year.

Huddersfield.—Wages.—The following negotiations between the Corporation Wages Committee and representatives of the workmen of the electricity and gas departments, it was agreed that double time for Sunday work, instead of the existing time and a half, should be paid as from April 1st until such time as a national award is made, the men agreeing to accept such award when it is made.

Keighley.—Loan Application.—The T.C. has approved the Electricity Committee's proposal to apply to the L.G.B. for power to borrow £72,773 to meet expenditure already incurred (£39,773), and estimated to be required during the next two years (£33,000). In the electricity department. It was stated that the Committee had at present applications for additional power amounting to 1,600 H.P., and, on the present load, four of the five boilers are kept steaming at full capacity. It was recommended that an additional water-tube boiler be installed, capable of evaporating 35,000 lb. per hour, and that certain extensions and alterations to the buildings be made.

Kidderminster.—Power Supply.—In reply to the criticisms passed at a meeting of the local Chamber of Commerce as to the shortage and unreliability of the electric power in the borough, the Shropshire, Worcestershire, and Staffordshire Electric Power Co. has informed the Chamber that the company was dismantling turbine plant and boilers of large capacity for immediate transference to the Kidderminster power station, and everything was being done to expedite the work and give to the borough largely increased power.

Lancaster.—Proposed New Plant.—A deputation has been appointed to report on the production of electricity with up-to-date plant, and, if necessary, to inspect plant at other towns. There is also a suggestion regarding the production of electricity from the River Lune.

Llandyssil (Cardiganshire).—Proposed E.L. Supply.—It is reported that Mr. Isaac Thomas has acquired property in the town with a view to the establishment of E.L. works.

Leicester.—New Plant.—The Tramways and Electricity Committee has recommended the T.C. to erect a transformer house containing two 1,000-kw. rotary converters, at an estimated cost of £18,000. The tender of Messrs. Dick, Kerr & Co. for the plant was accepted in February last.

London.—Stepney.—Loan.—The Finance Committee reports having received a reference from the Electric Supply Committee upon the question of taking up loans for refunding money expended by consumers during the war for connecting their premises to the Council's mains. The Electric Supply Committee states that up to date £3,800 has been expended on house services, and £2,250 on meters, &c., and in order to provide capital for the future, recommends the Council to take up a loan of £10,000 in respect of house services, and £7,500 for meters. The Finance Committee recommends that application be made to the L.C.C. for sanction to borrow the above amounts.

Ludlow.—Prov. Order.—The R.D.C. has received an intimation from the gas company that the company intended to make an application under the Electric Lighting Act for an order to supply electricity to Craven Arms.

Nelson.—Year's Working.—There was a loss of £1,147 on the electricity undertaking, attributed to the increased cost of material and labour, restrictions on lighting, and the running of the light railways. There was a profit on the tramways of £705.

New Zealand.—Hydro-Electric Scheme.—New Plymouth B.C. proposes to borrow £40,000 for hydro-electric extensions.

The Waingawa Meat Co. estimates its firing costs at £17,000 per annum, plus the cost of handling and storage of 8,000 tons of coal, of which 5,000 tons is used for electric power purposes, costing £10,625 per annum. It is considered that by utilising the water power of the district that the cost would be eventually reduced by one half or less when the whole of Wairapapa was connected up.

E.L. Scheme.—The engineer (Mr. G. T. Wilson) has recommended an A.C. supply for the whole of the Hamilton, Claudelands, Hamilton East, and Frankston, N.Z., as this would place the electrical undertaking on a sound basis when the hydro-electric scheme eventuated. He considered that by going into the matter now the Council would hasten the Hora Hora scheme being made available for local bodies.—*Tenders.*

Peterborough.—Expert Advice.—The T.C. has decided to obtain expert advice on the suggested development of the electricity works, which proposes capital expenditure of £100,000 or more.

PROPOSED EXTENSIONS.—A report has been presented by Mr. T. Rowland, the acting city engineer, in which he questions whether it is worth while expending large sums on the present plant. He considers the time is ripe for remodelling the generating plant and providing H.T. transmission. The expenditure may amount to £100,000 or more.

Ripon.—PROV. ORDER.—The City Council has adopted the E.L. Committee's recommendation to apply for a prov. order for the supply of electricity next September.

Rochdale.—BULK SUPPLY.—The Town Council has approved the agreements for the supply of electricity in bulk to the Committee to meet the big demands. At the Town Council meeting last week, Alderman Walker referred to the recent decision to apply for sanction to borrow £68,500 for the electricity undertaking, and outlined the scheme. The output of the works, after 18 years' working, had reached an approximate total of 16 million units per year. It was expected that the output for the D.R. Cotton Mills in the next two years would alone exceed 20 million units, and a still further increase by other firms of 7 million units was expected. With such large demands the Committee had considered the extension of the present station, but it could not recommend that course, whilst the erection of a new power station would involve capital expenditure of £400,000, and could not be completed in time. It had, therefore, decided in favour of a bulk supply from an adjoining authority. Oldham and Bury Corporations were asked to submit estimates, and later the Lancashire Electric Power Co., and the Manchester Corporation. Manchester would not be able to supply for some 2½ years, and the Corporation had accepted the tender of the Lancashire Power Co. The terms were very reasonable, and would not handicap local consumers. The Power Co. would be responsible for all expenditure on plant, mains, &c., outside the Rochdale boundary, expenditure in the borough being incurred by the Corporation. It was mainly this for which the loan was required, and the L.G.B. had intimated that an inquiry might not be necessary. The agreement with the Power Co. would be for 10 years, and it would contain clauses to cover any increase or decrease in the cost of labour. The Corporation's offer to the D.R. Mills had been accepted, and it was also for a period of 10 years. The Committee would be prepared to consider the question of the renewal of the contract at the end of six years. The D.R. Mills Co. would require the full load of 8,000 KW. by about July, 1920.

Shanghai.—NEW PLANT.—The municipality is endeavouring to get the two 2,000-KW. A.E.G. turbo-alternators, which have given considerable trouble in the past, repaired in Japan, after which they will be used as stand-bys. Another 18,000-KW. G.E.C. unit has been ordered, and four boilers, each of 80,000 lb. per hour capacity, are to be ordered. It is expected that the capacity of the plant will reach 103,000 KW. by 1924.

South Wales.—THREATENED STRIKE.—The stokers at the South Wales Electric Distribution Co.'s power station at Treforest claim to come under the Sankey Award, and threatened to strike on Monday unless the claim is granted by the company.—*S.W. Daily News.*

Stoke-on-Trent.—NATIONAL ELECTRICITY SUPPLY.—It has been decided to oppose the Walsall Corporation (Extension of Electricity Powers) Bill, which seeks powers to supply electrical energy in the Cannock and other areas.

EXTENSIONS.—Five tenders for building extensions at the central power house were considered by the E.S. Committee, and that of Mr. T. Godwin, amounting to £13,059, was accepted and a contract entered into. The tender of the Stirling Boiler Co., Ltd., amounting to £29,000, has been accepted, and the necessary contract entered into for the extension of three water-tube boilers.

STREET LIGHTING.—Following a report by the borough surveyor on the percentage of pre-war lighting now reinstated in the borough, it was recommended that the 50 per cent. basis for street lighting be not exceeded at the present time, except in the case of lighting by electricity.

Wallasey.—L.G.B. APPLICATION.—The Electricity Committee has decided to recommend that application be made to the L.G.B. for sanction to borrow £11,300 for the extension of the electricity station, including mains required during the next three years.

Watford.—LOAN SANCTION.—The U.D.C. has received sanction for loans amounting to £19,550 for E.L. purposes.

York.—LOAN SANCTION.—The T.C. has obtained sanction for loans of £10,685 for mains and £4,315 for services, sub-station, and transformers.

TRAMWAY AND RAILWAY NOTES.

Birmingham.—NEW TRACK.—A new form of tramway track was submitted to a town meeting last week in connection with a Bill being promoted in Parliament. Rails carried on a sleeper track are proposed as a feature of great ring roads which are being designed as part of the town planning schemes. The track will occupy the middle of the thoroughfare, but it will be higher than the rest of the roadway and have appointed crossing places. The scheme was approved.

Blackpool.—ADDITIONAL TRAMCARS.—The Tramways Committee has decided to purchase six second-hand tramcars from the London United Tramways Co.

Bradford. — PERMANENTWAY RECONSTRUCTION. — The Tramways Committee is putting in hand, at once, certain reconstruction of lines and roadways, and is also resuming work in connection with the extension of the Thornbury depôt, held up during the war, so as to help to provide work for the unemployed.

Bury.—YEAR'S WORKING.—It was reported to the T.C. that on the Bury sections of the tramways there had been a profit of £8,277 during the past year, and on the Radcliffe sections a profit of about £500. Wages during the year had increased by £10,168. The gross traffic receipts showed an increase of £20,300.

Bacup Corporation is to send a deputation to the L. & Y. Railway Co., pressing for better railway facilities for the town. Electrification of the line to Bacup and a better service are chiefly desired. The company is also to be asked to establish a service of circular trips for motor tramways between Bury, Bacup, and Rochdale.

Continental.—PORTUGAL.—The daily Press reports that the strike of the electric tramway employés still continues.

Glasgow.—MAINTENANCE AND RENEWALS.—A Special Committee of the T.C. has recommended that work in connection with the maintenance of the tramway track and cars be proceeded with as fast as possible, but that further extensions be delayed until repairs on the existing lines are completed. The Committee has also recommended that one mile of single track be treated with the rail-hardening process *in situ* by Messrs. Scholey & Co.

Golcar.—PROPOSED MOTOR-'BUS AND TRAMWAY SERVICE.—The U.D.C. has decided that negotiations be re-opened with the Daimler Co., Ltd., the Yorkshire (Woollen District) Electric Tramways Co., Clayton & Co., Ltd., Messrs. Tilling, Stevens, Thorneycroft and Co., Ltd., and the Huddersfield Corporation respecting the provision of motor-'buses and tramways for the district.

Halifax.—TRAMCAR TIRES.—The tramway engineer has been authorised to purchase 25 tramcar tires from John Brown & Co., Ltd., Sheffield, at the price of £45 per ton, and a similar number at the same price from Brown, Bayley's Steel Works, Ltd., Sheffield.

DEPÔT EXTENSION.—The tramways engineer has been instructed to prepare plans and estimates required for the extension of the Skircoat tramway depôt.

Haslingden.—BULK SUPPLY.—As the result of a conference between the Accrington, Rawtenstall, and Haslingden T.C.'s regarding the supply of electricity in bulk to the latter authority, satisfactory terms have been arranged.

Hull.—WAGES.—The Tramways Committee has acceded to the request of the car depôt nightmen engaged on general repairs and maintenance that their working hours be considered, and that they be placed on the same footing as the men doing the same class of work during the day—*i.e.*, 47 hours per week, with extra pay for overtime—and that any overtime worked since January 1st last, when the alteration was made to the hours of the day men, should be paid for.

Lanarkshire.—STRIKE.—Developments are announced by the daily Press in connection with the tramway employés' strike in Lanarkshire, now entering upon its third week. The Miners' Union has called upon all miners in the county to abstain from using the cars, and representations are to be made to the B. of T., and to the local authorities to take over the system as a going concern. The Miners' Executive has been guaranteed substantial backing in its appeal to the B. of T. The tramway company is endeavouring to maintain the service with imported labour. It has 20 cars on the system, and claims that all routes are being served. The "blacklegs" complain that housing accommodation cannot be found, and that landladies decline to give lodgings to imported labour. The company's solicitors have published an advertisement offering a reward of £10 to those who furnish information of specific threats by Union officials, or others, to the new employés of the company.

Leeds.—CONDUCTRESSES.—Tramway conductresses have now all been replaced by demobilised soldiers. Since 1916 1,500 girls have been employed in this capacity, and as cleaners and armature winders.

London.—TRAFFIC CONGESTION.—London Members of Parliament are taking up the whole question of traffic in London—tubes, tramways, and 'buses—and also the question of fares. The view is taken that the present acute congestion is a passing phase, but the need of greater facilities for dealing with a big permanent increase in traffic is regarded as imperative. The construction of more underground railways will, it is understood, be urged.

At a meeting on Monday last, Mr. F. Pick, representing the electric railways and motor-'bus services, delivered a statement regarding the profits and expenses of the undertakings during the war, the reasons why the fares had been increased, and the arrangements that were being made to improve transportation facilities. The meeting afterwards adopted a resolution calling on the Government to appoint a Select Committee to consider what could be done to relieve the congestion of traffic. Mr. Pick stated that between 1914 and 1918 the traffic increased by 92 million passengers a year; owing to the decreased number of omnibuses available, the railways carried 152 million passengers more in 1918 than in 1914—an increase of 69 per cent. The traffic of London had increased abnormally during the war. The tube railways had been unable to

renew their rolling stock, and the number of cars available had diminished. The company had works in hand that would cost £3,650,000; the cost of one mile of tube railway, fully equipped, was £1,000,000. It had built up a reserve fund of £1,904,000 to replace the existing fleet of 'buses, the average life of an omnibus being five years; the normal cost would be £1,000 per 'bus. The average dividend paid on all the company's stock was 3·64 per cent. At present 40 trains per hour were run on the District Railway—the maximum possible. The total number of passengers carried in 1918 was 901 millions. The fares on the railways have been raised by 33⅓ per cent. during the past six years.

Increased Train Facilities.—From Monday last the District Railway was to have resumed running through trains between Ealing, Acton Town, and Southend.

Commencing Monday last the Metropolitan train service on the Willesden, Harrow, and Uxbridge lines was to have been increased between 10 a.m. and 4 p.m.

Increased train facilities will also be provided on the District Railway on Sundays to Kew Gardens and Richmond.

On the Hampstead line there will be a five-minute service between Charing Cross and Golders Green, and Charing Cross and Highgate, between 10 a.m. and 1 p.m. This will provide a 2½-minute service between Charing Cross and Camden Town.

On the Bakerloo the quarter-hourly service between the Elephant and Castle and Watford will be reinstated. Additional theatre trains will be run.

Stepney.—The Finance Committee reported that the resolution containing the Council's consent to the proposed extension of the L.C.C. tramways to Aldgate Station and the Council's recommendation that an extension of the tramways down Mansell Street to the Tower Hill area, returning by way of the Minories, had been received by the County Council, and in reply it was intimated that the suggestion would receive careful consideration in connection with the preparation of further tramway proposals.

Burdett Road Electrification.—An informal conference with the L.C.C. was held recently on the condition of the carriageway in the Burdett Road and the question of electrification from West India Docks to Cassland Road. As a result, the L.C.C. intimates that that the Highways Committee of the L.C.C. considers that any proposal for electrifying this route must provide for the overhead system, which has already been agreed upon by neighbouring B.C.'s, and inquiring if the local Council would now be prepared to agree to the use of this system, and pointing out that the Council had since June 24th, 1903, consistently refused to sanction the use of the overhead system. After further consideration, the Works Committee of the B.C. recommended that the L.C.C. be informed that the Council does not see its way to the use of the overhead system on the portion of the route in question.

Owing to the high tide in the Thames, on Sunday night, at Kew Bridge, the North London Railway line, which is in a cutting below the level of the river, was flooded for about an hour. The electricity had to be cut off, and the Acton and Kew trains could only just reach the London end of the platform.

Newcastle-upon-Tyne.—Year's Working.—The report for the year ended March 31st, 1918, shows that the revenue amounted to £418,028, compared with £356,534, the traffic revenues having been £409,114 and £346,334 respectively. Working expenses had gone up from £203,299 to £248,394, and the gross profit was £169,634, against £148,235. The balance left in the reserve and renewals fund was £155,251, against £105,894.

Street Accidents.—Last year, according to Home Office figures issued last week, 262 people were killed and 7,294 injured in tramway street accidents in the British Isles. For London the figures were 57 killed and 2,817 injured.

The Transport Bill.—Omnibus Routes.—In the House of Commons Committee on the Transport Bill, on Tuesday, an amendment was agreed to, providing that where a licensing authority refused to grant a licence for a new omnibus route or imposed conditions, the applicant should have the right of appeal to the Ministry of Ways and Communications, which should have power to make an order.

TELEGRAPH AND TELEPHONE NOTES.

Aerograms.—In a lecture, on April 30th, before the Industrial Reconstruction Council, on "The Aeroplane in Industrial Development," Mr. Holt Thomas gave some details of a projected scheme of communication which combined the telephone or telegraph with the aeroplane. Messages sent by the system would be described as aerograms. The general idea was to telephone or telegraph a message to the aerodrome, where it would be taken down in shorthand, carried, say, to France in a plane, and forwarded there to its destination. Such a system would be invaluable for dealing with long Press cables. A message of 3,000 words between Paris and London could be delivered by aeroplane long before it had got across the cable. Moreover, the aeroplane would probably be carrying millions of words and other things as well at the same time. The economy in labour by the use of such a method would be enormous. The public would have to pay for speed in the aerial mail.—*The Times.*

Australia.—Mr. E. T. Fisk, managing director of Amalgamated Wireless (Australasia), Ltd., in the course of a statement concerning the offer made by the Marconi Co. to establish a direct wireless service between Great Britain and Australia, stated that the cost of erecting the necessary high-power stations in England and Australia would probably amount to something like £100,000, and the Marconi Co. was prepared, at its own expense and risk, to do that. The company did not ask for any monopoly of trans-oceanic wireless communication, and its proposals consisted merely of an offer to provide valuable service and to send and receive messages at the outset for one-third less than the existing cable rates. The only concession asked for by the company was that its terminal wireless station should be connected with the inland telegraph system, so that the messages could be promptly dispatched over the Post Office lines to and from all parts of Australia, and that the necessary permission be given to erect a station. The company undertook to hand over the station, if required, immediately upon the outbreak of war.

Cable Delays.—Cable conditions are seriously affecting British commerce in the Far East, says the *Times*. Ordinary telegrams are taking from 10 to 14 days to reach their destinations, and the privilege of being able to send urgent messages operates only from China, and not from Britain. Meanwhile cables to America are getting through in two days—ironically enough, *via* Australia and Canada.

Duplex Wireless.—Mr. E. F. W. Alexanderson, of the General Electric Co., Schenectady, N.Y., on April 2nd, delivered a highly important technical paper before the Institute of Radio Engineers, New York, describing interesting results relative to duplex radio telegraph and radio telephone operation, together with highly selective and stray-reducing receivers. The title of the paper is "Simultaneous Sending and Receiving."—*T. and T. Age.*

Japan.—An exchange to connect wireless and wire telephones was established in Kobe, Japan, at the beginning of the year by the Government Department of Communications, states *Wireless Age*. A wireless tower, 180 ft. high, is now being erected in front of the largest of the Kobe telephone exchanges. Wireless telephone messages from vessels within 100 miles of the South Japan port will be connected by central operators with the telephones of subscribers in Kobe, Osake, Kyoto, and neighbouring cities, thus serving the most densely populated section in Japan.

London-Paris Wires.—Preparatory to the calling of the Peace Conference, the British Government laid 10 private telephone lines between Paris and London, including cables under the Channel, not touching the system owned by the French Government at any point. All wires and cables are covered with lead, preventing tapping.—*Telephone Engineer.*

New Zealand.—Press and telegraph censoring ceased as from May 2nd.

Snowstorm Damage.—Interesting figures regarding snowstorm damage to telephone lines in the South Lancashire district on January 4th, are given in the *P.O. Electrical Engineers' Journal*. Manchester telephone district comprises 39 exchange areas, including trunk and local lines. The overhead mileages are:—Main lines, 9,172; local lines, 22,639 miles. Trunk routes nearly all carry between 50 and 60 wires; many local routes carry over 100 wires, and some over 150. The snow froze on the wires as it fell, to an estimated diameter of 2 in., and some of the heavy lines were entirely wrecked. There are about 25,500 exchange lines and external extensions in the district. Of these, 12,849 were listed as faulty on January 6th, and on March 15th the number had increased to 25,637. By the latter date, 22,688 faults had been cleared, leaving a balance of 2,949 outstanding. The maximum listed at one time was 14,782. At one time there were over 5,700 subscribers' line faults in the Manchester City area, also 250 junction faults, and 1,500 of the 2,000 private wires were interrupted. On the evening of January 11th, the Manchester Corporation power mains broke down, and burned through two cables carrying about 500 subscribers' lines. The list of damage was as follows:—Number of poles broken, 120; down, 150; deflected, 4,954. Roof standards damaged, 3; stays broken or down, 6,632. Length of wire to be re-erected, 8,700; regulated, 7,900 miles. With the exception of slight damage in the Lymm Exchange area, the whole of the Liverpool telephone exchange area escaped.

The Telegraph and Telephone Services.—At the annual dinner of the Newspaper Society on Tuesday last, the Postmaster-General stated that additional underground cables were to be laid for both telegraphs and telephones, and between six and seven millions would be spent this year on the improvement of the services. The number of Government telegrams dealt with had increased from 44,000 in February, 1914, to 875,000 in February, 1919, and private messages had increased by 10 per cent.

The Postmaster-General stated in the House of Commons that the numbers of Government telegrams in the first quarters of the years 1914, 1918, and 1919, were 145,856, 2,624,599, and 2,687,807 respectively.

The Postmaster-General is to be asked if he can arrange for the carriage of telegrams to Paris by the ordinary daily train, by which they would reach Paris in 10 hours, and might be delivered at once without the delay of two, three, and even four days which takes place now when they are telegraphed over by wire.

U.S. Cables.—Mr. Burleson, Postmaster-General, announced, on April 29th, that the cables which the Government took over shortly after the armistice was signed would be returned to their owners not later than May 10th. Telegraph and telephone

wires would be returned to their owners "as soon as legislation could be obtained from Congress safeguarding the interests of owners."

A powerful new wireless equipment, the nature of which is a secret, was used on the recent trial flights of American seaplanes preparatory to the trans-Atlantic flight, says *The Times*.

Wireless telephones are to be used by the fire patrols in the national forests of the United States.

Wireless Weather.—An Admiralty notice to mariners in the *London Gazette* gives particulars regarding the system of collecting meteorological data from vessels at sea in all parts of the world, by wireless telegraphy, by means of which it is hoped that accurate forecasting of the weather will be greatly facilitated. Endeavours are being made to secure international agreement on methods of procedure; in the meantime the British Meteorological Office is developing the scheme.

CONTRACTS OPEN AND CLOSED.

(*The date given in parentheses at the end of the paragraph indicates the issue of the* ELECTRICAL REVIEW *in which the "Official Notice" appeared.*)

OPEN.

Australia.—BRISBANE.—June 18th. Brisbane City Electric Light Co. Supply of rotary converters (specification 10s. 6d.) from the offices of the company at Brisbane.—*Tenders.*

SYDNEY.—June 9th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.*

June 23rd.—Municipal Council. One 60-ton electrically-driven overhead travelling crane. Electric Lighting Department, Town Hall, Sydney.

London.—L.C.C.—May 12th. 5,000 driving-wheel tires, and 3,500 trailing-wheel tires for electric tramways. General Manager, L.C.C. Tramways, 23, Belvedere Road, Lambeth, S.E.

LAMBETH.—May 20th. B. of G. One electrically-driven hydro-extractor. Boardroom, Brook Street, Kennington Road, S.E.

Manchester.—May 21st. Electricity Committee. Wet air filter for the Stuart Street station. (May 2nd.)

Natal.—May 20th. Corporation. 12 miles steel girder rails (95 lb. per yd.) with fishplates, bolts and nuts, and 4,300 tie bars, and 1,500 copper rail bonds and 300 cross bonds. Webster, Steel & Co., Agents to the Durban Corporation, 5, East India Avenue, E.C.

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

CLOSED.

Australia.—P.M.G.'s Department, Victoria :—

Telephone accessories, £2,137.—Western Electric Co. (Aust.), Ltd.

Department of the Navy—
Underground cables and accessories at Flinders naval base, £6,650.—W. T. Henley's Telegraph Works Co., Ltd.
Insulators, &c., £307.—Australian Porcelain Co. (Pty.), Ltd.
Electrical materials, £115.—Lawrence & Hanson Electrical Co., Ltd.
Cables, £631.—Noyes Bros. (Melbourne) (Pty.), Ltd., £1,491.—B. I. and Helsby Cables, Ltd.

SYDNEY.—City Council—
H.T. cables, £12,716.—B. I. & Helsby Cables, Ltd.—*Tenders.*

Chorley.—B. of G. The Liverpool Electrical Engineering Co., £2,235, for the lighting scheme at the Institution.

Halifax.—Electricity Sub-Committee. Chloride Electrical Storage Co., Ltd. Battery for the ashes vehicle at the electricity works, £236.

London.—HACKNEY.—Electricity Committee. Recommended :—

Replacement of economiser, £1,185.—E. Green & Sons, Ltd.

Sub-station switchgear :—

Johnson & Phillips, Ltd. ..	(recommended)	**£7,183**
B.T.H. Co., Ltd.	.. ..	8,120
A. Reyrolle & Co., Ltd.	.. ..	8,125
Ferguson & Pailin, Ltd.	.. ..	8,548
British Westinghouse E. & M. Co., Ltd. ..	.. ..	8,766

STEPNEY.—B.C. Maintenance of storage battery at Whitechapel sub-station; renewal of contract for a period of 10 years. The Tudor Accumulator Co. asked that the rate of consideration should be revised from £34 per annum to £44 per annum, the Council, in addition, paying at the end of each half-year a further sum of 6s. 6d. for every £1 by which the average price of lead exceeds £15 per ton, should the mean daily quotation of foreign lead in the Public Ledger exceed that amount; this is intended to provide for variations in the price of lead. The Council has decided to enter into a new agreement on the terms proposed.

Coal-handling plant for Limehouse station—

E. Bennis & Co., Ltd. ..	(not including tackle and labour) ..	£788
Goodall, Clayton & Co.	.. ..	997
New Conveyor Co., Ltd. ..	.. (accepted)	**761**
Babcock & Wilcox, Ltd.	.. ..	1,448

Lamp standards—
12 standards for street lighting, £135.—British Mannesmann Tube Co., Ltd.

The Electricity Committee has accepted the following offers for coal for the electricity works :—

E. Foster & Co.—1,000 tons nutty slack, at 29s. 4d. per ton; 3,000 tons of West Cannock p.s. nuts, at 33s. 1d. per ton; 2,000 tons 2-in. nutty slack, at 27s. 7d. per ton.
A. Blackmore & Co.—150 tons Granville Derbyshire 1½-in. nutty slack, at 29s. 6d. per ton.

HAMMERSMITH.—Annual contracts. Recommended :—

Electrical goods.—General Electric Co., Ltd.
Insulated wires (flexible cord).—Macintosh Cable Co., Ltd.
Copper fuse wire.—B. I. & Helsby Cables, Ltd.
Meters.—Electrical Apparatus Co., Ltd.
Insulating compound.—Dussek Bitumen Co.

250 yd. L.T. concentric cable—

Pirelli-General Cable Works, Ltd.	(recommended)	**£118**
Western Electric Co., Ltd.	.. ..	122
Callender's Cable and Construction Co., Ltd. ..	.. ..	128
British Insulated & Helsby Cables	.. .. ..	128 10

W. T. Henley's Telegraph Works Co., £980 per mile, £129 per length.

Additional boiler-house plant. Structural steelwork—

Measures Bros. (1911), Ltd.	(recommended) ..	**£434**
H. Young & Co., Ltd.	.. ..	536
Aston Construction Co., Ltd. ..	.. ..	587
Foster Construction Co.	.. ..	605

Safety Tread Syndicate, Ltd. (total sum not quoted).

Morecambe.—T.C. Tanks and water cooler for the electricity department. Mr. Gardner, £270.

Salford.—Electricity Committee :—

One 300-K.V.A., three-phase transformer, £460; one E.H.T. oil-switch cubicle, £278.—British Westinghouse E. & M. Co., Ltd.
Renewal of economiser, £1,270.—E. Green & Son, Ltd.

Having regard to increased labour costs due to Government awards the Council is recommended to agree to the payment of £250 to the British Westinghouse E. & M. Co., Ltd., as compensation for increased expenditure in the manufacture of plant recently supplied to the electricity department for £7,341.

Stoke-on-Trent.—B.C. Accepted :—

Extension of three water-tube boilers, £29,000.—Stirling Boiler Co., Ltd.

York.—T.C. Tramway curves. Hadfields, Ltd., £1,648.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, May 9th. At 7.30 p.m. At 39, Victoria Street, S.W. Lecturette on "Pneumatic Tires as Applied to Road Vehicles, and their Automatic Inflation," by Mr. R. Barnfather, junr.

Friday, May 16th. At 7.30 p.m. At 39, Victoria Street, S.W. Paper on "Notched Bar Tests," by Major H. P. Philpot.

Royal Institution of Great Britain.—Saturday, May 10th. At 3 p.m. At Albemarle Street, W. Lecture on "Chapters in the Psychology of Industry; Modern Industrial Organisation, where it fails to observe the Humanities of Industry, and the Result," by Prof. H. S. Foxwell.

National Foremen's Association, Engineering, Shipbuilding and Allied Trades (West London Branch).—Saturday, May 10th. At 6.30 p.m. At the Norfolk Arms Hotel, Burwood Place, Edgware Road, W. Ordinary meeting.

Industrial Reconstruction Council.—Tuesday, May 13th. At 5.30 p.m. At the Institute of Journalists, Tudor Street, E.C. Conference on "Costing in Relation to Scientific Management," to be opened by Mr. J. H. Boyd (Director of Costs and Efficiency Methods, Ministry of Munitions).

Wednesday, May 14th. At 4.30 p.m. At the Saddlers' Hall, Cheapside, E.C. Lecture on "The Economic Limits of Nationalisation," by Brig.-General Cockerill, C.B., M.P.

Royal Automobile Club.—Wednesday, May 14th. At 8.15 p.m. At Pall Mall, S.W. Paper on "Electric Vehicles," by Mr. F. Ayton, Hon. Secretary of the Electric Vehicle Committee of Great Britain.

Royal Society of Arts.—Wednesday, May 14th. At 4.30 p.m. At John Street, Adelphi, W.C. Paper on "Railway Transport in the United Kingdom," by Mr. H. Kelway-Bamber.

Institution of Electrical Engineers.—Monday, May 12th. At 7.30 p.m. At the Chartered Institute of Patent Agents. Informal meeting; discussion on "The Regulations Issued by Electricity Supply Undertakings," introduced by Mr. W. E. Bradshaw.

Wednesday, May 14th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Wireless in the Royal Air Service," by Major J. Erskine-Murray, R.A.F.

Thursday, May 15th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "The Telephone Service of Large Cities, with special reference to London," by Mr. E. A. Laidlaw and Mr. W. H. Grinsted.

(**North-Eastern Centre**).—Monday, May 12th. At 6.45 p.m. At the Mining Institute, Newcastle. Annual general meeting and lecture on "Dielectrics in Electric Fields," by Mr. G. L. Addenbrooke.

(**North-Midland Centre**).—Tuesday, May 13th. At 7 p.m. At the Metropole, King Street, Leeds. Annual general meeting, and discussion on "The President's Address to the Territorial Centres."

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

FURTHER contributions received in response to the appeal made by Mr. Hunter, the chairman, are as follow :—

H. A. Burge	£0 10 6	F. W. Maine	£1 0 0
Waste Heat & Gas Co. ..	15 0 0	H. Greenwood	10
T. Bolton & Co.	1 1 0	H. C. Wellden	10

NOTES.

The Hopkinson Chair of Thermodynamics.—For the Bertram and Cecil Hopkinson Memorial Trust Fund, Mrs. John Hopkinson has offered £2,000 towards the endowment of another chair connected with the School of Engineering in order to carry on the work so brilliantly developed by her son, Colonel Bertram Hopkinson, C.M.G., Professor of Mechanism and Applied Mechanics, who lost his life while flying last August. The professorship is to be called the Hopkinson Chair of Thermodynamics. A further sum of £1.000 is offered by Mr. George A. Wills, £500 by Mr. Melville Wills, and £250 by Mr. Stanley Wills.—*The Times.*

Paris May-Day Celebrations.—Serious disturbances took place at Paris during the celebration of May Day, resulting in considerable casualties. The Metropolitan and Nord-Sud Railways, as well as the tramways, stopped running, and the electric generating stations closed down at 7 in the morning. Certain employés in the electrical and gas works ceased work for 24 hours, and shift workers stopped work for two consecutive hours on each shift. At least one lightless interval occurred during the hours of darkness. Telephone operators stopped work for half an hour at ten and again at five in the evening.

Institution and Lecture Notes.—Institution of Electrical Engineers.—On Thursday evening last week, Dr C. Chree, F.R.S., delivered an interesting lecture on "Magnetic Storms," before the Institution. The lecture opened with a statement regarding the title, which sounded rather ambitious. It was not meant to be so, it had been chosen to differentiate between natural and artificial storms. Disturbances set up by tramways and electric railways were sometimes worthy of being called storms. The first part of the lecture dealt with records taken in the U.K., and the second half with records taken all over the world, including some taken by the Scott Expedition in the Antarctic. A large number of slides were shown, the lecturer giving a most interesting explanation of how and why records taken in different parts of the world differed. Certain similarities in some of the records were also explained. The lecturer laid stress upon the importance of selecting suitable instruments according to which stations they were to work in. It was sometimes assumed that an instrument could be moved from one station to another, and give equally good results at both places, but that was by no means the case. An instrument that would not be quite sensitive enough, say, in Europe, if taken to the Antarctic might be so sensitive that the recording needle would sweep off both edges of the chart, and most of the record would be lost. Interesting magnetograph charts taken simultaneously, but in different parts of the world, were shown on the screen, the manner in which they differed being explained.

The times of day or night at which magnetic storms occurred most frequently and of the greatest intensity were discussed. Until recently they could say very little about those times with certainty, but some important work had been carried out lately in connection with the Institute of Mining Engineers. This point was of particular interest to surveyors, as it was essential to know the exact magnetic conditions during a period of time in which a survey was being carried out. A day or night might be practically free from disturbances when taken on the whole, yet during that day or night quite violent disturbances might occur, lasting perhaps only a few seconds, which would introduce serious errors into calculations if not allowed for. Generally magnetic storms were more frequent and violent during the night, and this point should be remembered as it was general practice in observatories to take records at night. It was also shown that identical disturbances might occur for several days in succession, then disappear, and reoccur later exactly as before.

With regard to the criticism levelled against Kew Observatory, the lecturer said that excellent work had been done there, and it was essential to keep magnetographs running there in spite of all drawbacks. He, personally, was not alarmed by the artificial disturbances which were said to affect Kew; if the whole facts were considered, other stations might not prove to be as free from disturbance as they were generally thought to be. In his opinion, Eskdalemuir station in Scotland was by no means ideal, it had many drawbacks, and was subject to more disturbances than was apparent. If the whole of the facts which they now knew had been taken into account, he thought they would never have gone to Scotland for such a station. The point that did really trouble him was whether they had not exaggerated the external interference at Kew in the past. It had been assumed that the instruments at Kew were similar to others of the same type used elsewhere. It was now found that in reality they were about 30 per cent. more sensitive, and this point would very probably account for the large number of records taken in the past, which were supposed to be seriously affected by external influences.

In conclusion, the lecturer stated that much important work had recently been carried out, and when the examination of certain records from other parts of the world had been completed, very interesting facts would become available.

An interesting discussion on the electric furnace took place at the inaugural meeting of the SHEFFIELD SUB-CENTRE of the Institution which was held on April 29th. The Institution has recently adopted the plan of sub-dividing its organisation, and the advantages of this method were explained to the meeting by the President (Mr. C. H. Wordingham). The excellent attendance at the meeting was an augury for the success of the new sub-centre. Mr. R. H. Campion, of Dewsbury, presided. Four papers were presented: "The Booth-Hall Electric Furnace," by Mr. W. K. Booth; "Electric Furnaces in the United Kingdom, 1918," by Mr. R. G. Mercer, of the Ministry of Munitions; "A New Type of Electric Furnace," by Mr. A. Sahlin; and "Large Electric Steel-Melting Furnaces" by Mr. Victor Stobie. Mr. S. E. Fedden (general manager of the Sheffield Corporation electricity department), gave an interesting *résumé* of the growth of the use of electric furnaces in Sheffield. In 1902, pig and scrap iron were made into steel on a commercial basis. The man from Sheffield, however, took some time before he would even try the experiment. In 1914 they put in one furnace; in 1915, three (one of which was the first war furnace); in 1916, 11 furnaces, taking 13,000 KW.; in 1917, 18 furnaces, taking 14,000 KW.; and in 1918, seven furnaces; altogether they connected up, in a very short period, furnaces taking an output of no less than 35,400 KW. They had the ordinary load in addition. They obtained from the Ministry a permit to put down a special telephone system, and got in connection with all the furnaces. This arrangement was of very great assistance, and enabled them to take on more furnaces than they really ought to have done. Mr. Fedden analysed some figures of output given in Mr. Mercer's paper, arriving at the conclusion that the steel manufacturers' load-factor was only 15 per cent. He said if they asked anybody else what they ought to pay, for a 15 per cent. load-factor, they would be given a figure of 3d. to 3½d. Yet the Sheffield Corporation, at which they were always shouting on the score of high prices, had been giving it them for 0·6d., and practically losing 3d. a unit, for the benefit of steel-making in Sheffield. Mr. Ernest Wells, of Edgar Allen & Co., said that when he went to the Ministry of Munitions electric furnaces were very much over-rated. The output of good steel castings from the electric furnace until quite late in the war was negligible. However, his own firm had confidence in electric furnaces. Mr. Travis (Sheffield) took exception to Mr. Wells's statement. He said he thought all manufacturers resented Mr. Wells's action at the Ministry. The fact was that people who had stock converters or other methods of making castings in their works, and who installed electric furnaces, had shut down their other plant and carried on the electric furnaces, which proved conclusively that the electric furnace gave them the result they required at the lowest cost. The very fact that Messrs. Edgar Allen & Co. had installed two electric furnaces, which he understood were ordered just before the Armistice, showed their belief in the furnace which Mr. Wells attempted to damn to everyone else. Mr. Howard (Sheffield Corporation) expressed the opinion that in many of the older furnaces the voltage was far too low. It ought to be increased by 25 per cent. This would lead to a considerable reduction in cost.

At last week's meeting, the president (Mr. C. H. Wordingham) read a letter from Mr. J. J. Fahie, M.I.E.E., offering to present the Institution with a number of books, documents, and articles, some of which dated back a considerable number of years, and which were of considerable interest to engineers. The Council had that afternoon considered the offer, which had been gratefully accepted.

Röntgen Society.—An X-ray photograph of the interior of the carburetter of an aeroplane engine, showing a block in the petrol feed, was one of many interesting exhibits, on April 29th, when a joint meeting of the Röntgen and Faraday Societies discussed radio-metallography. It is now possible to take photographs through 2 in. of hard steel, and to detect flaws in castings and new alloys. A difference in thickness of a 200th part of an inch is revealed in a steel casting 2 in. or 3 in. in thickness by X-ray photography. Prof. Bragg, F.R.S., showed X-ray photographs of various mechanisms in which flaws were detected without taking the intricate parts to pieces.

Royal Institution.—The annual meeting was held on May 1st, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the Committee of Visitors for the year 1918, testifying to the continued prosperity and efficient management of the Institution, was read and adopted; 24 new members were elected in 1918, and 63 lectures and 19 evening discourses were delivered. The following gentlemen were amongst those elected as officers for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Brigadier-General E. H. Hills.

Diesel Engine Users' Association.—The announcement was made at the last meeting that the Committee had further considered the question of endeavouring to obtain better terms from the Inland Revenue authorities with regard to the allowance made for depreciation of Diesel and semi-Diesel engines in connection with income-tax assessment, and the constitution of a Special Committee to deal further with the matter was approved. The Association has already been instrumental in obtaining somewhat better terms for the users of Diesel engines, but the position of users of semi-Diesel engines in the matter is very unsatisfactory. Those interested in this subject are invited to communicate with the Honorary Secretary, at 19, Cadogan Gardens, London, S.W. 3.

A suggestion that the new French Association of Manufacturers and Users of Internal-Combustion Engines should be affiliated was cordially approved.

Mr. H. S. Brackenbury gave a report of an explosion which had occurred on a Diesel engine at Wealdstone, and an interesting discussion followed. It was decided that the matter should be discussed further at the following meeting of the Association, when the breakdown of a Diesel engine at Weymouth is also to be reported by Mr. G. W. F. Horner and discussed.

Electricity in Agriculture.—Durham County Council has had a resolution sent to it by the North-Eastern Agricultural Federation, emphasising that present-day requirements in connection with agriculture require that the utmost use should be made of electricity.

Legal.—SCOTT ANDERSON *v.* CLAYTON & SHUTTLEWORTH, LTD.—On Monday, May 5th, in the King's Bench Division, Mr. Justice Rowlatt heard an action by Mr. T. Scott Anderson, of Sheffield, against Messrs. Clayton & Shuttleworth, Ltd., of Lincoln, in which plaintiff claimed for a balance of £1,263 10s. alleged to be due for the price of goods sold and delivered, and charges for storage, insurance and carriage.

Mr. Lewis Thomas, K.C., for the plaintiff, said that the action was brought in respect of the balance of the price of certain electrodes. Plaintiff carried on business as a manufacturing engineer at Sheffield, and defendants at the time of the transactions were manufacturing munitions. In November, 1916, Mr. Anderson was asked to tender for different gauges of electrodes for electric welding. In 1917 a quotation was made for 750,000 ft. of gauge 8 electrode, which was accepted. The first instalment was duly delivered and paid for. Then a question was raised about infringement of patent. The Quasi-Arc Co., Ltd., of London, were suggesting that the plaintiff's electrode might be an infringement of their patent. Mr. Anderson said he would indemnify defendants for any liability for any action brought with regard to infringement of the alleged patent of the Quasi-Arc Co. Plaintiff still took up the attitude that he was making his electrodes long before the Quasi-Arc Co. got a patent. Ultimately it was arranged that plaintiff would leave unclaimed £500 of the price of his material for six months after the completion of the contract for 750,000 ft. of electrodes. Defendants had always retained that £500. On Russia going out of the war, defendants wrote plaintiff not to make any more deliveries. Plaintiff replied that he was prepared to meet their convenience, but said that an instalment of 100,000 ft. was on the way. That was accepted, and only the final instalment remained. After negotiations, defendants' representative assented to plaintiff's suggestion that he should retain the last instalment, and try to dispose of it for them on condition that they returned his £500. On his reminding them of their promise to release the £500, they replied that the matter was receiving their consideration. Plaintiff sued for the balance of £1,263, which included the £500.

In their defence, defendants said it was agreed that 100.000 ft. of electrodes delivered pursuant to order February 5th, 1917, being part of the order sued on, should be returned to the plaintiff, and the order form should be kept open, and the defendants should not be required to take delivery of the 100,000 ft. until March, 1919. The 100,000 ft. invoiced October 31st, 1918, were never ordered by, and had been rejected by the defendants. As to the balance of the claim, after deducting £750, the price of these invoiced goods, the defendants said they were entitled to retain £500, for the plaintiff agreed that the defendants should retain this sum as an indemnity against claims made by the Quasi-Arc Co. against the defendants for alleged infringement of patent in respect of the electrodes, and that such sum should be retained until a decision was legally made that plaintiff was not infringing this or any other patent.

After hearing Mr. R. W. Turner, for the defendants, and Mr. Lewis Thomas for the plaintiff, Mr. Justice Rowlatt gave judgment for the plaintiff for £500 only, the action for £750 being premature. The defendants, said his Lordship, were entitled to some relief as regarded the costs.

Draughtsmen Taking Action.—At the half-yearly Conference of the Association of Engineering and Shipbuilding Draughtsmen, which concluded on Sunday, at Birmingham, it was decided to ask branches to give authority to incorporate in the rules of the Association an instruction that members should only offer their services to those employers who submitted their vacancies to the Association. It was reported that a strike of draughtsmen at Rochdale—the first on record—ended successfully for the members concerned.—*The Times.*

Standards for the Measurement of Electricity.—The Board of Trade announces that the coils and instruments referred to in the Schedule to the Order in Council of January 10th, 1910, which approved the several denominations of standards set out in that Schedule as denominations of standards for the measurement of electricity, as from May 8th, 1919, will be deposited at the National Physical Laboratory, instead of at the Board of Trade Standardising Laboratory, Whitehall. All communications respecting electrical standards and instruments for test should be sent to the Director of the National Physical Laboratory, Teddington, Middlesex.

Peace Celebrations.—We learn from the Director of the Electrical Development Association, as we go to press, that the Board of Trade (Coal Mines Department) has confirmed the statement which we published recently—namely, that the D.O.R.A. orders with regard to public lighting and illuminations will be suspended for four days, in order to permit of the due celebration of the return of Peace. The dates will be announced later.

Appointments Vacant.—Test-room assistant (£160 to £180), for the Wakefield Corporation Electricity Department; electrical inspector, for the War Department, Northern Command; meter tester (45s. + 28s. 6d + 12½ per cent.); and installations inspector (50s. + 28s. 6d. + 12½ per cent.), for the Walsall Corporation Electricity Supply Department; shift engineer (£234), for the Corporation of Accrington Electrical Engineering Department; chief of the Electrical Engineering Department (£400), for the City of Coventry Technical Institute; two shift engineers (£200), for the Kilmarnock Burgh Electricity Works; charge engineer (80s.), switchboard attendant (60s.), for the City of Gloucester Electricity Works; assistant engineer (£500), for the Stalybridge and Hyde Joint Tramways Board; shift engineer (76s. 7d.), for the Corporation of Ayr Electricity Works; meter and test-room assistant (50s. + bonuses), for the Borough of Islington Electricity Department; assistant to electrical engineer and tramways manager (£200 to £300), and charge engineer, for the Keighley Corporation Electricity Works; chief assistant in Testing Department (£400), for the City of Manchester Electricity Department; electric wireman (67s.), for the Croydon Mental Hospital; Shanghai Municipal Council require the services of the following: Boiler-house chemist, 350 taels per month; assistant mains engineer, 400 taels per month; two assistant mains engineers, 350 taels per month; assistant draughtsman, 350 taels per month; assistant installation inspector, 230 taels per month; assistant meter tester, 230 taels per month (the tael may be taken as equivalent to 3s. on the average, the present rate of 5s. is abnormal). See our advertisement pages to-day.

Goodby-ee.—At Accrington, on April 30th, there was a re-union with demobilised Service men, and opportunity was taken to say *au revoir* to the female servants in the employ of the Tramways Committee. Alderman T. E. Higham, chairman of the Electricity Committee, paid a tribute to the Service men, and presented the Meritorious Service Medal to Sergeant G. Rushton, of the 15th Hussars, a member of the staff.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—The St. Helens Corporation Tramways Committee has appointed to the position of tramways engineer and manager Mr. W. BELLAMY, who was previously assistant at St. Helens under the company. Mr. Bellamy is a son of the late engineer to the Liverpool tramways. He has been in the Army since 1914, and has put in four years' service in Rangoon. The St. Helens tramways will be taken over from the company by the Corporation on the expiration of the lease this autumn; but Mr. Bellamy's appointment dates for some months ahead of that period.

The Newcastle-under-Lyme Town Council has increased the salary of the borough electrical engineer, Mr. A. J. C. DE RENZI, to £390 per annum.

Three electric supply men from other towns have been asked to appear before the Morecambe Council on May 13th for interview concerning the appointment of electrical engineer vacant through the resignation of Mr. A. W. Annetts.

The Bridlington T.C. was recommended to increase the salary of Mr. A. J. BECKETT, borough electrical engineer, from £375 to £475 per annum, inclusive of bonus, rising by annual increments of £12 10s. to £500. On Monday the Bridlington Electricity Committee resigned *en bloc* as a protest against the Council rejecting its recommendation.

Mr. E. W. SLEIGHT, manager of the Carlisle Tramways Co., has resumed duty after service with the Royal Fusiliers and the K.O. Royal Lancaster Regt. He was severely wounded.

Mr. C. A. WALKER, rolling stock superintendent at the Rotherham Tramways Depôt, who is leaving to take up a similar appointment at Lowestoft, has been presented by the staff with a leather suit case. He is succeeded by Mr. Sharpe, of Bradford.

Mr. LONG, electrical engineer to the Grays U.D.C., has retired from the position.

Stoke-on-Trent B.C. Electricity Supply Committee has decided that the maximum salary of the electrical engineer be fixed at £1,000 and that his salary be increased from £700 to £900 as from April 1st last, and that he be granted two further increases of £50 on April 1st next and April 1st, 1921.

The Heston and Isleworth Electric Lighting Committee recently decided to adhere to its previous decision requiring Mr. RYCROFT, the electrical engineer, to resume his full-time duties on March 31st. The clerk, acting on the instructions of the committee, wrote to him to that effect, adding: "If you do not comply with the Council's request, your non-return will be understood as, and will be taken to be, a termination of your engagement as electrical engineer and manager." Mr. Rycroft has replied stating that as far as he was concerned, it was not understood that by failing to comply with the committee's requirements his engagement was terminated. The committee has again confirmed its decision.

Captain F. H. BRANDRETH has resigned the post of resident engineer and manager to the Urban Electric Supply Co., Ltd., at Stamford, in order to accept a similar appointment with the same company at Grantham.

Mr. C. L. HOLMAN has resigned the post of resident engineer and manager of the Lymington Electric Light and Power Co., Ltd., in order to accept a similar appointment with the Urban Electric Supply Co., Ltd., at Stamford.

The Hull Corporation Tramways Committee held several meetings during the month of April at which the position of the tramways manager was under discussion. At one of these it was resolved to ask him to submit his resignation.

This Mr. W. J. McCombe did under date April 26th, and it was accepted unanimously, but the committee in reporting the matter to the Council asked that body to express its opinion as to whether having regard to the strain under which his work had no doubt been carried on during the war it would be possible to reinstate Mr. McCombe in his late or some similar position. The Council discussed the matter fully on May 1st and with one dissentient it was resolved that Mr. McCombe be not engaged in any capacity under the Corporation. One of the speakers said that it was known last December that there was something wrong in the office. Another member said he had lost all confidence in the committee as well as in the manager; he thought that the committee should resign, and that there should be a public inquiry into the finances and management of the undertaking. This attack on the committee was described by subsequent speakers as a scandalous one, and it was denied that the "irregularities" were known about a year ago.

General.—The Electrical Research Committee has appointed Mr. E. B. Wedmore, who is at present with the B.T.H. Co., Ltd., as Director of Research.

Mr. G. S. Lockwood was last week presented with a pair of bowls by the employés in the general stores of Messrs. Dick, Kerr & Co., Ltd., car works department, Preston.

The *Times* states that Sir Ernest Rutherford, the newly-appointed Cavendish Professor of Experimental Physics at Cambridge, has been elected to a Fellowship at Trinity.

Major K. Edgcumbe, M.I.E.E., London Electrical Engineers, has been restored to the establishment of the corps, of which he was a supernumerary officer whilst employed extra regimentally. Major Edgcumbe has been long associated with the London Electrical Engineers, and rose to field rank in July, 1914, a few weeks before the war opened.

Captain J. Young, A.M.I.E.E., has been engaged by the Cray Laboratory, Sugar House Lane, Southampton, as manager of their electrical engineering department. During the war he has served in the Tyne Electrical Engineers, R.E., and the R.A.F., previous to which he was employed in the estimating department of Messrs. Reyrolle & Co., Ltd., Hebburn-on-Tyne.

Major Frank Vandervell, who has just started in partnership with his brother, Lieut. Percy, under the name of "Vandys" as motor car agents, &c., at Pembridge Gardens, Notting Hill Gate, was from 1902 and until the outbreak of war intimately connected with Messrs. C. A. Vandervell and Co., Ltd., at Acton, of which his brother Charles is the head. The Major was mobilised two days before the declaration of war (being then a member of the Artists' Rifles), and served with distinction both in Gallipoli and France.

Mr. F. Raylton Hodges, late manager for Baker Bros., Middlesbrough, has now taken up the management for Messrs. T. B. Morley & Co., Ltd., Jameson Street, Hull, where he is inaugurating an electrical supplies department, and invites information from actual manufacturers of accessories, &c.

Captain S. B. Haslam, R.E., M.I.E.E., M.I.Mech.E., who has been in the Army since 1914, and in Salonika for the last three years, has now been demobilised, and has rejoined Messrs. Haslam & Stretton, Ltd., as joint managing director. The firm are extending their operations, and will shortly be opening additional premises at 33, St. Helens Road, Swansea.

The appointment of Mr. William Noble to the position of engineer-in-chief at the G.P.O., in succession to Sir William Slingo, who will retire at the end of this month after 50 years' service, is one that will command the approval not only of the staff of the Post Office, but also of the public generally. Mr. Noble, like his predecessor, has risen from the ranks, and in every grade through which he has passed he has given proof of the possession of exceptional qualities and sterling merit; he entered the service of the Post Office in 1877 as a telegraphist in the Aberdeen office, and from the first took a keen interest in the technical side of his work, as evidenced by the winning of medals in both telegraphy and telephony. For some years he was a lecturer in those subjects, and in magnetism and electricity, and many of his students honoured his efforts by becoming medallists. For some years he has been one of the examiners of the City and Guilds of London Institute.

In 1893 Mr. Noble was appointed second-class engineer at Aberdeen, and in 1897 he was promoted to a first-class engineership in the engineer-in-chief's office, where his character and ability soon made themselves felt. He took part in the preparations for the development of the P.O. telephone service, and in 1901 he became assistant superintending engineer in the Central Metropolitan District, in which capacity he was responsible for a large share of the telephoning of London. In 1905 he became a first-class staff engineer, and took charge of the Telegraph Section at Headquarters; two years later he was appointed superintending engineer of the Central Metropolitan District, a post which gave full scope to his administrative capacity, as well as his technical knowledge. In 1910, with the Controller of the London Postal Service, Mr. Noble visited Berlin, Vienna and Paris to investigate Continental practice, and he has served on many technical and advisory committees with great distinction. He was promoted to the onerous position of assistant engineer-in-chief in 1912, and since then has been engaged on work of the first importance.

Mr. Noble's technical qualifications for his new post, it will be seen, are of the first order; they are equalled by his personal characteristics—his friends are legion, and when we

Photo by [*Elliott & Fry.*

Mr. W. Noble.

tender him our sincere congratulations on the high honour which his merits have gained for him, we but echo the sentiments of all his well-wishers.

CITY NOTES.

Indo-European Telegraph Co. Ltd.

Mr. J. H. Tritton presiding at the annual meeting, on April 29th, said that during 1918 their communications remained totally interrupted between this country and Russia. Their lines in Russia were being repaired, and they hoped before long to have the line through between Odessa and Teheran. Owing to the unsettled state of Russia it was impossible to make any forecast. We have had many difficulties to contend with during the war. In Persia the wires were subject to constantly recurring interruption by the marauding bands of Turks who were constantly raiding parts of the territory traversed by their line. During the armistice period there had been fighting between the Georgians and Armenians, and again their line suffered. The country south of the Caucasus had always been a danger zone owing to the large number of Kurds who occupied many villages in that district, and these tribes had been particularly active during these troublous times. The fighting in the Northern Caucasus between the Turks and Russians also led to total interruptions, but they had been able to restore communication between Odessa and Tiflis, although for the moment they were again interrupted on that section. There still remained the section of line between Tiflis and the Russo-Persian frontier, but the company was receiving every assistance from the British military authorities and Georgians, and they hoped that before long they would be able to get the line through. It would be some time before it was in a pre-war condition. The cable between Odessa and Constantinople was reopened for telegraphic traffic on December 1st, 1918, and had been working satisfactorily since that date. The Odessa end of the cable was worked by this company's staff, but communication was, they believed, again suspended. Although this cable linked their system with that of the Eastern Telegraph Co., the carrying capacity of the cable was only sufficient for the local traffic, and they were unable to use it for India or trans-Indian traffic. They had made definite proposals to the British Government for the restoration and strengthening of the Indo route, and these proposals were under consideration. The whole question must, to a great extent, depend upon the peace terms. They were acutely alive to the shortcomings of the present telegraphic communication with India and the East, and were extremely anxious to leave no stone unturned to re-establish that portion which was their own concern. The directors were carefully following developments in radio communication. Great strides had been made during the war, more especially in reception, and it was quite possible that the company might avail itself of radio communication to strengthen further its communications with the East. The

accounts for 1917 had recently been issued. Owing to the liberal action of their partners in the Cis-Indian Joint Purse, there was a sufficient sum, after crediting local traffic receipts and interest on their reserves, to pay all expenses and provide a dividend of 7 per cent. on the share capital of the company. There was no balance to account for, and there were, consequently, no special allocations to reserve funds. They could only hope that when the peace terms were settled, the British Government would be able to determine what route should be followed by the company in the future. They wished to utilise to the fullest possible extent the excellent lines of communication that they possessed in Russia and to ensure the provision of their efficient route with the minimum of capital outaly.

W. T. Glover & Co., Ltd.—The result of trading in 1918 was a credit balance of £38,673. Added to this is the balance brought forward, £10,770; excess profits refund, £4,859; cash investments balance, £966; making £55,269. Deducting directors' remuneration and expenses and the interest on the 4½ and 5 per cent. debenture stocks, also £4,000 transferred to the trustees of the second debentures, £42,091 remains. Out of this the 5 per cent. preference dividend is paid, less tax, £3,562, there is transferred to the first mortgage debenture redemption fund £2,500, the dividend of 5 per cent. and bonus of 2½ per cent. on the ordinary shares, less tax, absorbs £6,137, £20,000 is transferred to reserve, and £9,891 is carried forward. The first debenture redemption fund now stands at £48,000, the second ditto at £49,000, and the reserve fund at £100,000, making a total of £197,000. The annual meeting will be held on Monday at Trafford Park.

In a circular which has been issued to the shareholders, under date April 30th, 1919, the chairman, Mr. A. L. Ormrod, states that the directors have recently been approached on behalf of Vickers, Ltd., with a view to that company acquiring the controlling interest in the company by means of an exchange of shares. As the result of negotiations Vickers, Ltd., have now agreed to purchase the shares from the respective holders, or such of them as think fit to adopt the agreement, at the following prices: For every preference £1 share, 17s. 6d. in cash; for every four £1 ordinary shares, five fully-paid £1 ordinary shares of Vickers; Ltd. Both shares will be delivered ex dividend. Further, it is proposed that the shares in Ashover Mines, Ltd., held by W. T. G. & Co. (and which stand as an asset in the company's balance sheet at £23,907), shall be reserved for or distributed amongst its ordinary shareholders by way of a special dividend. Unless at least two-thirds in value of the preference shareholders and nine-tenths in value of the ordinary shareholders agree to sell their shares to Vickers, Ltd., that company will have the right to determine the agreement. The directors are of opinion that the terms of the sale are favourable to the shareholders, and will agree to sell their own shares accordingly. The completion of the sale is to take place on June 30th next.

Anglo-American Telegraph Co., Ltd.—The three quarterly interim dividends on the preferred and ordinary stock paid in May, August, and November, absorbed £157,500, and the directors on February 1st last paid the final dividend for the year on these shares and 30s. on the deferred stock. These payments absorbed altogether £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1½ per cent. on the deferred stock. A bonus of 1s. 9d. per cent. upon the ordinary stock and 3s. 6d. per cent. upon the deferred stock was paid on February 1st, 1919. The balance at credit of revenue account (£66,932) includes £1,307 interest received, and the balance of £65,625 is available for the payment of dividends for the quarter to March 31st, 1919.

North of Scotland Electric Light & Power Co., Ltd.—With further reference to the report summarised last week, the connections in Montrose increased during 1918 from 1,173 KW. to 1,217 KW.; in Brechin they increased from 837 to 857 KW.; and in Inverness from 1,784 KW. to 1,996 KW., making a total of 4,070 KW. connected in the three towns. In order to meet the large power demands in Montrose it will be necessary to purchase extra generating plant before next winter. Additional capital is to be sanctioned for this purpose.

Craigpark Electric Cable Co., Ltd.—Net profit for year ended March 31st, 1919, £11,028, after making provision for excess profits tax, plus £932 brought forward. To depreciation of buildings and machinery, £2,000; to reserve, £2,000; 6 per cent. on the preference shares, £2,850; 8 per cent. on the ordinary shares, £3,000; carried forward, subject to directors' fees, £2,110. The business has been maintained over the period covered. Next year it is proposed to hold the annual meeting in June instead of May.

Melbourne Electric Supply Co., Ltd.—Interim dividend on the consolidated ordinary stock at the rate of 10 per cent. per annum, free of British income tax.

Evered & Co., Ltd.—It is proposed to increase the capital of the company, and, in view of the probable amalgamation with other companies, the directors propose to bring the present articles of association up to date. The capital is to be increased to £300,000 by the creation of 100,000 new shares of £1 each.—*Financier.*

Ramsgate & District Electric Supply Co., Ltd.—Including £665 brought forward the gross profits for 1918 were £2,690. After allowing for interest at the rate of 5 per cent. per annum on outstanding accounts due to contractors, the balance is £1,543, of which £800 is put to reserve and £743 carried forward. Mr. A. D. Chamen has been appointed a director in place of Mr. W. T. Pressland, deceased.

Shanghai Electric Construction Co., Ltd.—Dividend of 5 per cent. and bonus of 5 per cent. (together 20s. per share), less tax, on the ordinary shares, making 15 per cent. for the year; £10,000 to reserve for renewals; £8,000 written off preliminary expenses; £19,103 carried forward, subject to excess profits duty.

Alderley & Wilmslow Electric Supply, Ltd.—During 1918 the total lamp connections increased from 1,193 KW. to 1,218 KW. The profit was £2,133, against £2,664 for 1917. £996 was brought forward. Interest on debentures and loans £1,597. To reserve £1,000. Carried forward £532.

Oriental Telephone & Electric Co., Ltd.—Final dividend of 3 per cent. on the preference shares, less tax, making 6 per cent. for the year; 6 per cent. on the ordinary (free of tax) making 10 per cent. for the year. Annual meeting: May 29th.

Globe Telegraph & Trust Co., Ltd.—Final dividends now announced bring the total for the year on the preference shares to 6 per cent., less tax, and that on the ordinary to 8 per cent. net.

Marconi International Marine Communication Co., Ltd.—An extraordinary meeting, held last week, confirmed the special resolution increasing the capital by the creation of 900,000 shares of £1 each.

City of Buenos Ayres Tramways Co. (1904), Ltd.—Dividend of 1s. 3d. per share (5 per cent. per annum), less income tax, for quarter ended March 31st.

Oldham, Ashton & Hyde Electric Tramways Co., Ltd.—Dividend at rate of 7 per cent. on the ordinary shares.

Adelaide Electric Supply Co., Ltd.—Interim dividend on the ordinary shares at the rate of 10 per cent. per annum, free of British income tax.

Auckland Electric Tramways Co., Ltd.—Interim dividend of 6d. per share, less tax, on ordinary shares.

Calcutta Electric Supply Corporation, Ltd.—Final dividend on ordinary shares for last half of 1918, 6¼ per cent. actual, plus a bonus of 1 per cent., making a total of 11 per cent. for the year.

Vickers, Ltd.—Final dividend of 1s. 6d. per share, free of income-tax, on the ordinary shares.

British Ever-Ready Co., Ltd.—Final dividend of 10 per cent. on the ordinary shares.

Johnson & Phillips, Ltd.—Dividend for 1918 on the ordinary shares, 10 per cent. per annum.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets have been inflamed with strength by the unexpectedly favourable nature of the Budget. No increase in income-tax and a halving of excess profits duty took people by surprise. The Stock Exchange happened to be closed on the day after the Budget speech, and markets did not really get into swing until Monday in this week. Then there was a thorough rush to buy. Mostly to be affected were rubber and oil shares, with a few particular industrials. But the strength was very contagious and general. Investors, speculators, gamblers, all wanted to buy. The pace was over-hot to last. Reactions occurred in some cases. On the whole, however, prices kept the greater part of their rises, and the Stock Exchange is busier than it has been for fully five years.

In the markets covered by these notes, there has not been much change. The Budget cannot influence electricity supply companies to any great extent, while, so far as the cable group is concerned, the fact of income-tax being retained at the trifling (!) level of 6s. in the £ has rather cooled the recent ardour for securities upon which dividends are paid free of tax. The list of prices is well maintained, and a revived feature is a jump in Marconis to ¼ above the round fiver. Marconi Marines advanced to 5 1/16. American Marconis dropped back to 27s., from which price a smart recovery lifted them to 28s. 6d. It is announced that the United States Government is handing back to private control the American telegraph and telephone companies: Globe Telegraphs have risen to 15 on the declaration of a dividend making 8 per cent. for the year as against 7 per cent.

Home Railway stocks have advanced with the rest. Metropolitans and Districts are slightly better. Underground £10 shares rallied to 3¼ after a dip to 3¼: the income bonds did not move. Steam-cum-electricity stocks are decidedly better. Nobody seems quite to know why they should be, and the amount of business that brought about the change was meagre. Relief over the Budget is considered sufficient to account for any otherwise unexplainable movement. Invest-

ment stocks of most kinds are harder, and a renewed demand is experienced for all good-class pre-ordinary issues. Melbourne Electric 7 per cent. first cumulative preference are inquired for at 5¼, at which the yield comes to 6⅔ per cent. on the money. The security is excellent, and the preference dividend was covered, on the last figures, 6½ times over. North Metropolitan Electric Power 6 per cent. cumulative preference at 18s. 6d. ex dividend pay six guineas per cent. on the money. General Electric 6¼ per cent. preference at 10½ give 6½ per cent. on the investment; dividends are due January and July.

General Electric ordinary are a good market at 19. Rumour loves to play around these shares, and the latest concerns itself with possible developments on an important scale next month. Edison Swans, after being dull and heavy at 19s. 6d., have spurted to 22s. 6d., on the success of the new issue, and their supporters talk them higher in the near future. Did dignity and caution permit, we might feel disposed to underline this optimism. Electrical manufacturing shares of all kinds are very firm, for which the previously-mentioned reports of amalgamations and arrangements are, in the main, responsible. Electric Constructions are a good market at 13/16. Babcock & Wilcox hardened up in company with other engineering shares. Siemens have improved to 6¾.

In the foreign division, Brazilian Tractions are again better by reason of a rise in the milreis. Mexicans continue depressed, and the bonds of the utility companies are weak by reason of the revolution news. Anglo-Argentine Tramways second preference have fallen ½. British Columbia Electric deferred stock is 5 points lower on a small pressure to sell. Rubber plantation shares broke out into a condition akin to booming on the reduction in excess profits duty and the fact that no other impost has been substituted in its place.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price May 6, 1919.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	62	—	£5 8 16
Charing Cross Ordinary	4	4	93	—	5 18 4
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 4
Chelsea	6	8	8⅛	+⅛	4 1 1
City of London	8	8	11⅞	—	6 16 2
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 3
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 3 1
Kensington Ordinary	7	6	5½	—	5 2 2
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	6	8½	—	7 14 10
Metropolitan	4	5	8½	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	8½	—	6 18 6
St. James' and Pall Mall	9	10	7⅞	—	7 0 4
South London	5	5	2⅞	—	7 5 6
South Metropolitan Pref.	7	7	20/6	—	6 16 7
Westminster Ordinary	9	8	6½	—	6 8 1
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. T 1. Pref.	6	6	96½xd	—	6 1 10
do. Def.	1½	32/6	22½	+½	7 8 0
Chile Telephone	8	8	7⅞	—	5 8 6
Cuba Sub. Ord.	7	7	11½	—⅞	*6 7 4
Eastern Extension	8	8	16½	+½	*4 18 6
Eastern Tel. Ord.	8	8	162½	—	*4 18 6
Globe Tel. and T. Ord.	7	8	15	+½	*5 6 8
do. do. Pref.	6	6	10½	—	5 14 8
Great Northern Tel.	22	22	80½	—½	7 4 0
Indo-European	13	13	87½	—	5 18 0
Marconi	20	20	5⅛	+⅛	3 18 0
Oriental Telephone Ord.	10	15	2⅞	+⅛	6 3 0
United R. Plate Tel.	8	8	7,	—	*5 1 7
West India and Panama	1/3	1/3	1⅛	+⅛	*4 3 4
Western Telegraph	8	8	16½	—	*4 15 10
HOME RAILS.					
Central London Ord. Assented	4	4	83½	—	6 6 0
Metropolitan	1	1½	27	—	4 12 7
do. District	Nil	Nil	23½	—	Nil
Underground Electric Ordinary	Nil	Nil	8½	—	Nil
do. do. "A"	Nil	Nil	9⅞	—	Nil
do. do. Income	4	5	86	—	*5 4
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	42	—	6 11 4
Anglo-Arg. Trams. First Pref.	5½	Nil	8½	—	—
do. do. 2nd Pref.	—	—	3	—½	—
do. do. 5 Deb.	5	5	68½	—	7 8 5
Brazil Tractions	—	—	58	+½	—
Bombay Electric Pref.	6	6	102	—	5 11 7
British Columbia Elec. Ry. Pfce.	5	5	59	—	8 10 0
do. do. Preferred	Nil	Nil	34½	—5	Nil
do. do. Deferred	Nil	Nil	37½	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 4
Mexico Trams 5 per cent. Bonds	Nil	Nil	60	—1	Nil
do. 6 per cent. Bonds	Nil	Nil	47½	—1½	Nil
Mexican Light Common	Nil	Nil	37	—	Nil
do. Pref.	Nil	Nil	51	—	Nil
do. 1st Bonds	Nil	Nil	67	—1	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	32	+½	4 0 0
British Aluminium Ord.	10	10	11½	+⅛	5 18 6
British Insulated Ord.	25	12½	2½	—	6 1 1
British Westinghouse Pref.	7½	7½	24	—	6 3 0
Callenders	25	25	10	—	6 5 0
do. 6½ Pref.	5	6½	5½	—	6 3 10
Castner-Kellner	25	20	8½	—	6 8 1
Edison-Swan, "A"	—	—	1½	+½	6 13 4
do. do. 5 per cent. Deb.	4	5	75½	—	6 12 3
Electric Construction	10	10	1.⅜	—	8 8 6
Gen. Elec. Pref.	6	6½	10⅜	—	6 5 4
do. Ord.	10	10	19	+½	*5 5 0
Henley	25	25	24	+½	6 0 0
do. 4½ Pref.	4½	4½	5⅞	—⅛	5 16 2
India-Rubber	10	10	16⅜	—	*5 0 4
Siemens Ord.	—	10	6¾	+½	*7 8 0
Telegraph Con.	20	20	25	+½	4 15 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 7th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	..
a Ammoniac Sal	per ton	£80	..
a Ammonia, Muriate (large crystal)	"	£78	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£45	£2 inc.
a Copper Sulphate	"	£42	..
a Potash, Chlorate	per lb.	1/9	..
a " Perchlorate	"	1/9	..
a Shellac	per cwt.	£12	£1 inc.
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers	"	£31	..
a " Lump	"	£28	..
a Soda, Chlorate	per lb.	10d.	1d. dec.
a " Crystals	per ton	£70	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 3' to 12' basis)	per lb.	11½d.	..
c " Tubes (solid drawn)	"	1/9½ to 1/9½	..
c " Wire, basis	"	1/-	..
c Copper Tubes (solid drawn)	"	1/4	..
g " Bars (best selected)	per ton	£114	..
g " Sheet	"	£114	..
g " Rod	"	£114	..
d " (Electrolytic) Bars	"	£81	..
d " " Sheets	"	£161	..
d " " Wire Rods	"	£91	..
d " " H.C. Wire	per lb.	11-⅞d.	..
f Ebonite Rod	"	..	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/6	..
h Gutta-percha, fine	"	11/-	..
h India-rubber, Para fine	"	2/4½	..
i Iron Pig (Cleveland warrants)	per ton	[illegible]	..
i " Wire, galv. No. 8, P.O. qual.	"	£40	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	9d. to 4/6	..
e " " " medium	"	5/- to 10/-	..
e " " " large	"	12/6 to 25-/& up.	..
d Silicium Bronze Wire	per lb.	1/3½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	£223 to £224	..
n " Wire, Nos. 1 to 16	per lb.	4/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Joint Industrial Council for the Electricity Supply Industry.—The first meeting of the above Council was held at the Offices of the War Cabinet, 2, Whitehall Gardens, London, S.W., on May 1st. Mr. G. J. Wardle, C.B., M.P., Parliamentary Secretary to the Ministry of Labour, who presided during the early part of the proceedings, pointed out that this was the thirty-third Joint Industrial Council to be set up, and the fourth Council which had been established for industries or services in which Local Government Authorities were concerned, the Councils for the Waterworks Undertakings Industry, Local Authorities' Non-Trading Services, and the Gas Industry having held their first meetings on April 3rd, April 11th, and April 30th respectively. The Joint Industrial Councils for the electricity supply, gas, and waterworks undertakings industries include both municipal and company-owned undertakings. The constitution of the Electricity Supply Joint Industrial Council provides for the appointment of a chairman and a vice-chairman, selected from the members of the Council, one from each side of the Council, and two secretaries, one for each side of the Council. Ald. W. Walker, of the Incorporated Municipal Electrical Association, was elected chairman, and Mr. A. de Turckheim, Secretary of the Incorporated Association of Electric Power Companies, was appointed secretary *pro tem.* for the employers' side of the Council. The Trade Union side of the Council will nominate the vice-chairman, and will appoint its secretary at an early date. All communications for the Joint Industrial Council should be forwarded for the present to Mr. A. de Turckheim, Sanctuary House, 33, Tothill Street, Westminster, S.W.1.

Shaft Pressing.—A method of heat shrinking instead of press fitting parts of electrical machines on to their shafts is described in the February issue of the *General Electric Review*. The method overcomes the difficulties usually experienced with press fitting on the erection site. For flywheels and couplings water or steam heating is used, while for armatures and field systems rheostats placed in convenient positions are found to be quite satisfactory. One case cited is that of a large armature, the shaft being 35 in. in diameter. Cold pressing was expected to require a maximum pressure of 600 tons, whereas heating the armature to about 80 deg. C. enabled the shaft to be pulled in with a 5-ton chain hoist.

LARGE POWER TRANSFORMERS.

By A. G. ELLIS, A.M.I.E.E., and J. L. THOMPSON, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

While British manufacturers have had ample opportunities of taking a front place so far as large turbines and generators are concerned, equal opportunities have not been afforded in transformer and switchgear work. This has been due largely to the limited home demand for such apparatus, which demand will, in the near future, be much extended, and British manufacturers have experience available which will cope with this demand.

For home service it is desirable to transport transformers complete in their tanks, thus minimising erection work and cost. Where possible it is also desirable to ship the transformer complete in oil, generally obviating drying out on site.

The size of transformer which can be transported and handled complete is limited, first, by the loading gauge

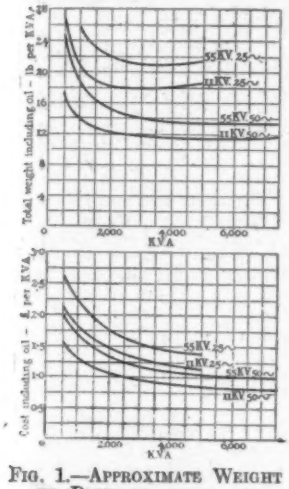


Fig. 1.—Approximate Weight and Price per K.V.A. for Self-cooled Transformers.

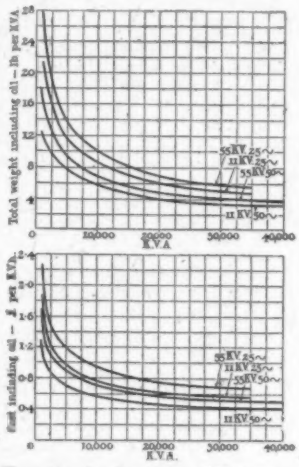


Fig. 2.—Approximate Weight and Price per K.V.A. for Force-cooled Transformers.

restriction and maximum truck size and loading, and second, by the handling facilities and crane capacity on the customer's premises.

The maximum rating of single and three-phase transformers of the self-cooled and artificially cooled types which can be shipped complete (with terminals removed) is given in Table I.

TABLE I.

Cooling.	Shipment.	Phase.	Periods.	Limiting rated output.	Approximate total weight complete with oil.
				K.V.A.	Tons.
Self-cooled	Complete in oil	1	50	3,000	17†
			25	2,000	20†
		3	50	5,000	30†
			25	3,500	33†
	Transformer and tank separately	1	50	6,000	30‡
			25	4,000	32‡
		3	50	7,000	42‡
			25	5,000	48‡
Water-cooled or forced cooled*	Complete in oil or dismantled.	1	50	10,000	26
			25	6,500	30
		3	50	15,000	42
			25	10,000	45
Forced cooled only*	Complete in oil	1	50	25,000	37§
			25	12,500	40§
		3	50	40,000	58§
			25	20,000	58§
	Dismantled	1	50	35,000	50§
			25	17,500	50§
		3	50	50,000	70§
			25	25,000	70§

* Weights include oil coolers for forced cooled transformers.
† Tanks built for shipment complete in one piece.
‡ Tanks with detachable external radiators.
§ Limiting ratings for a 50-ton crane to handle heaviest part.

In Table I are given approximate weights and dimensions. These data are based on, and developed from, the designs of the largest transformers that have actually been made.

Figs. 1 and 2 are representative curves of price and weight per K.V.A., of 3-phase, oil-immersed transformers, showing the influence of the following variables. These curves are all based on the British standard rating.

In general a large single-phase transformer is about 7 to 10 per cent. cheaper and about 12 to 15 per cent. lighter than a three-phase transformer of the same rating. A large three-phase transformer is, however, about 5 to 8 per cent. cheaper and 10 to 15 per cent. lighter than a group of three single-phase transformers of the same three-phase group capacity.

From the manufacturing standpoint any size of transformer can be constructed that is likely to be called for with the largest generating units. Assuming a 50-ton crane, the limiting rating for a three-phase 50,000-volt transformer would be about 50,000 K.V.A. at 50 cycles, and 25,000 K.V.A. at 25 cycles.

On the average, large 25-cycle transformers are 35 per cent. dearer and 40 per cent. heavier than 50-cycle transformers of the same rating.

The curves are shown for high-tension voltages of 11,000 and 55,000 volts, and for a maximum low-tension voltage of 6,000 volts. The price and weight increase by 1 per cent. for the smaller ratings, down to 0.6 per cent. for the largest ratings, per 1,000 volts normal pressure above 11,000 volts. The influence of the voltage is greater the lower the rated output.

The curves shown all refer to oil-immersed transformers, self-cooled up to the practicable limits of rated output (see Table I) and water-cooled or forced-cooled (with external oil circulation) for all rated outputs up to the maximum figures given in the table. At 1,000 K.V.A., 50 periods, the present-day prices of the self-cooled and water-cooled types are not appreciably different; the larger self-cooled units are, however, appreciably dearer than water cooled, up to a difference of 15 to 20 per cent. This may be to some extent offset in certain cases by the cost of water, pumping, storage, &c.

The system of cooling adopted is determined largely by the size of unit involved and the situation and cooling facilities available.

For isolated sub-stations where continual attendance is not available, self-cooled units are to be recommended up to 5,000 K.V.A. three-phase and 3,000 K.V.A. single-phase at 50

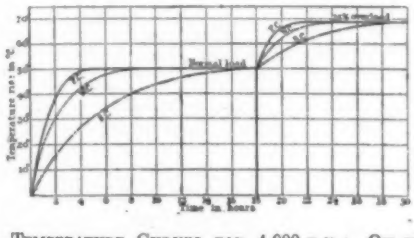


Fig. 3.—Temperature Curves for 4,000-K.V.A. Oil-immersed Transformers. S.C. = Self-cooled. W.C. = Water-cooled. F.C. = Forced Cooled. Copper Loss to Iron Loss = 2 : 1.

cycles. The same rule would apply for sub-stations and power stations with continual attendance where cooling water is dear.

There is a decided tendency nowadays towards large self-cooled units. In designing sub-stations, the following points should be borne in mind:—

Particular attention should be paid to ventilating the transformer chambers so that the air temperature should not be raised above 25 deg. C. if possible. Ample headroom should be provided above the transformer, and clearances allowed between the tank and any adjacent wall or cubicle should not be less than 1 to 2 ft. up to 1,000 K.V.A., and 2 to 3 ft. for larger sizes.

The quantity of air should be approximately 200 cu. ft. per min. per KW. loss for a temperature rise of air of about 10 deg. C.

In fireproof cubicles the ventilating apertures might be fitted with automatic dampers which would close at a set maximum temperature.

In power stations or sub-stations with attendance, where a plentiful and cheap water supply is available, water-cooled units are generally recommended for outputs above the following:—

Three-phase, 2,500 K.V.A., 50 cycles, or 1,700 K.V.A., 25 cycles; single-phase, 1,500, K.V.A., 50 cycles, or 1,000 K.V.A., 25 cycles.

Although water-cooled transformers (with internal cooling coils) can be built in very large sizes, forced cooling with external oil circulation is to be recommended above the following limits:—

Three-phase, 5,000 K.V.A., 50 cycles, or 3,500 K.V.A., 25 cycles; single-phase, 3,500 K.V.A., 50 cycles, or 2,500 K.V.A., 25 cycles.

The relative merits of single and three-phase transformers for three-phase groups have often been discussed. There is no specific rule which can be formulated, as the choice depends almost entirely on local conditions in each case. In general, where a number of groups are installed three-phase units will be more suitable, and where few groups are installed single-phase are preferable. In the latter case single-phase units ensure greater reliability of supply, as a group of three single-phase transformers operating in delta-delta can still run at about 58 per cent. of the group output with two of the transformers in open delta, should one transformer fail and be cut out.

In large sub- and central stations, where the number of units installed may be three or more, three-phase units will in general be preferred. If a number of three-phase units are installed, one complete three-phase transformer can be carried as a spare, without an undue increase in the capital cost. The floor space occupied will be appreciably less than for single-phase groups.

In sub-stations of plant capacity up to, say, 5,000 K.V.A. it will not generally be economical to install more than two or three groups. In such cases the choice tends towards single-phase units of medium capacity, forming one or two three-phase groups, with one single-phase transformer as spare for the sub-station.

With regard to the overload capacity of large power-station transformers of the water-cooled and forced-cooled types, the overloads specified for such step-up units should correspond to the generator overloads, since such transformers rapidly reach their final steady temperature. This is shown in the comparative curves in fig. 3. On such artificially cooled plant it is inconsistent to specify short-time overloads, as the plant for such overloads will generally have to be designed to stand the overload continuously.

It is desirable to rate such plant on the maximum continuous rating, as specified in the B.E.S.A. Report, so that both generators and transformers are capable of the same duty.

In sub-stations the most economical proportion of iron to copper loss depends on the load factor of the individual sub-station, and no specific rule can be laid down.

TABLE II.

Ratio of iron to copper loss	1 : 1	1 : 1·15	1 : 1·5	1 : 2
Efficiency at 1,400 K.V.A. ...	99·0	99·0	99·01	99·02
,, 1,500 K.V.A. ...	99·0	99·0	99·0	99·0
Iron loss, watts	7,500	7,000	6,000	5,000
Copper loss, watts at 1,400 K.V.A.	6,500	7,000	7,800	8,700
Copper loss, watts at 1,500 K.V.A.	7,500	8,000	9,000	10,000
Annual charge for losses at ¾d. per unit	£193	£193	£189·5	£188·5

An illustration of the method of arriving at the best proportion is set forth in Table II, which shows the annual charges for losses for different ratios of iron to copper loss for an average load of 1,400 K.V.A., peak load of 2,000 K.V.A., and normal rating of 1,500 K.V.A.

The above case is typical and shows clearly that where the load factor is high the ratio of iron to copper loss is of little importance. Similar considerations must be made for each individual case.

Specified overloads where required must be taken into account in conjunction with economical considerations in settling the most suitable proportions of iron and copper losses.

It is, however, becoming usual to adopt the British Standard rating. On this basis no overloads are permitted, the rating being the maximum for 50 deg. C. temperature rise in oil, at 40 deg. C. air temperature, giving a maximum oil temperature of 90 deg. C., which is the safe working limit.

Where the plant is not rated on this basis it is customary to call for a lower temperature rise of 40 or 45 deg. C., which allows for specified overloads. It is very desirable to rate all plant on the same temperature basis, and it is to be hoped that the British Standard rating will be generally adopted.

(To be concluded.)

Discussion at Newcastle-upon-Tyne.

On March 17th the paper was read and discussed before the North-Eastern Centre of the Institution of Electrical Engineers.

Mr. A. A. Hughes, opening the discussion, said the portion of the paper which appeared to call for most comment was that dealing with cooling. It should be borne in mind that for forced cooling continual attendance was not absolutely necessary, even though desirable. On their system they had forced-cooled transformers in sub-stations situate some distance from the nearest power station, and which were only visited one or twice during each shift. They installed in each transformer two thermostats, one operated a "buzzer" in the power station when the temperature of the oil reached 80 deg. C., and the other tripped the transformer switches when the temperature reached 90 deg. C. With regard to self-cooled transformers, he agreed that good clearances were necessary between the tank and the chamber wall. The authors' figures were on the small side, and he suggested allowing a clearance all round equal to half the width of the transformer tank. He thought sub-station transformers should be of the core type to facilitate repairs. Spare coils could be fitted in case of breakdown inside 24 hours, whereas a shell-type transformer had almost invariably to go to the makers for repairs. A further disadvantage of the rectangular-shell type was that the coils were not in direct contact with the oil. The wave-shaped distance pieces which formed the oil ducts would in time become blocked with sludge, and as to adjustable coil supports, he thought the arrangement of springs seemed to be the better one.

Mr. H. S. Ellis, referring to forms of protection between the high and low-pressure windings, said he was interested in that subject more particularly in small transformers. He had in mind Regulation 20 of the Home Office Rules, and also the B. of T. regulations.

Mr. Longman referred to the undue heating of the iron in transformers. Was there any likelihood, he asked, of transformer iron being improved in quality?

Mr. J. R. Beard referred to the limitation in the size of transformers being affected by the methods of transport, and suggested they might be conveyed by road. He drew attention to outdoor transformers, which were used a good deal in the U.S.A. He was surprised there had been no mention made of oil; it was a very important matter.

Mr. Stobie suggested that the change in the iron in transformers might be due to a change in the granular formation owing to the temperature at which transformers worked; the crystal grains, probably, would become greater than they were originally. They found that in steel that accounted for a great loss in physical qualities; it was possible, too, that there might be a chemical change, not a change of the total elements, but in the combination of elements in the steel itself.

Mr. J. L. Thompson, in reply, said that as to temperature rises, the figures given were based upon actual test results. As to protection between windings, personally he did not recommend earthing shields. They could be replaced by earthing a neutral point on one side of the low-tension winding and on one side of the transformer.

THE INDUSTRIAL SITUATION.

At the quarterly meeting of the British Electrical Federation, held on April 28th, Mr. E. Garcke delivered an address on "The Industrial Situation." He said that the war was not the only cause of the present unrest. It certainly had accentuated the troubles by increasing the cost of living, by giving the masses a greater consciousness of their power, and by strengthening the feeling that a nation which was able to spend seven millions a day for four or five years on war was not entitled to deny to the masses the means of decent subsistence. The war had, in many instances, torn the scales from the eyes of employers, and forced them to see things as they really were. By the light of this clearer vision many employers had come to regard conditions as intolerable which before had only seemed inevitable. This was especially true of the conditions in which unskilled labourers were living before the war.

A new readjustment of the social order of things was imperatively necessary if we wished to repair the economic ravages of the war, to inaugurate industrial peace, and to prevent a famine of capital a few years hence. The time and opportunity for introducing these changes had come; but we required enlightened public opinion and far-reaching statesmanship, and not merely time-serving politics.

Writers and speakers on the subject might be divided into three classes:—(1) Those who urged the supremacy of Capital and were for "fighting it out"; (2) those who claimed that Labour was paramount, and who advocated nationalisation, municipalisation, and other forms of communalisation, which would give Labour the control of industry; (3) those who took a middle course and looked for reconciliation and adjustment, and who advocated Whitley Councils, conferences, &c., as a means of settling disputes.

The third of these categories was a mixed one, including a large proportion of the people who were not interested in the aspirations of Labour or of Capital. Representatives of Labour and of Capital were also to be found among this class, recognising, as they did, that both Labour and Capital had just grievances against each other, and sincerely believing that the trouble could be lessened by a spirit of compromise, and by the enlightenment of the masses in economic principles. It also included a large sprinkling of people who were in the habit of letting others think for them, who, led or deterred by phrases which they did not take the trouble to understand, condemned the profiteer and added to the clamour for nationalisation and municipalisation.

It was mainly to the last of these classes that we had to appeal to find a permanent solution of the industrial difficulties.

The temporary settlement with the miners had been possible because they had in view the certainty of the Sankey Committee recommending nationalisation of the mines in some form. The nationalisation of railways would follow, and we should go from one industry to another in this direc-

tion. Nationalisation had been described as the last hope of a bankrupt statesman, because there was a feeling that there was no satisfactory alternative between unlimited competition and collectivism. When it was too late and the mists had cleared, we should find ourselves deluded; and then perhaps an effort would be made to find the natural equilibrium, and not merely the political mean.

It was the duty of every man who was able to think about these matters to formulate proposals with a view to strengthening the foundations, and not merely patching up the cracks in the wall.

The proposition which he submitted was that we should discard the dual conception of Capital and Labour, and regard the productive capacities of societies as conjoint for the production of the surplus necessary for continued progress. We required both Labour and Capital to utilise the resources of Nature. Capital and Labour were as the two halves of a pair of scissors, and we should make no headway in this discussion until we were thoroughly imbued with the conviction that either half by itself would do very little cutting. Without capital there could be no collective employment of labour, and in order to provide capital there must be abstinence, the reward for which was profit. Without labour there could be no use for capital, and to induce labour to make the best use of capital it must have its fair share of profit. There could be no industrial peace, nor any industrial progress, until Labour and Capital recognised that production must be increased, and that this could only be achieved by their concerted action, better organisation, and the far greater use of machinery. The belief that labour-saving machinery brought unemployment in its train must be dispelled. In 1907 the census of production showed that the net yearly output per worker was £102. It was surely clear that with such a standard of production it was not possible to attract capital and ameliorate the conditions of labour. But a knowledge that Capital and Labour were working to one end, and a knowledge that the more that was produced the richer was the community as a whole, would not be sufficient to assuage the unrest. What was required further was the creation of some satisfactory machinery for the distribution of the surplus or profit between the various parties who had contributed to its production, according to their claims, merits, and rights respectively.

The old ideas of profit-sharing were inadequate. Labour must be identified with the surplus—not merely entitled to a share of it dependent on sliding scales and other formulæ which had no permanent basis, but were apt to be upset by alteration of prices, new inventions, foreign competition, and other varying conditions. There must be complete economic combination of the elements of production—not merely an artificial mixture of parts which were oscillating, colliding, and conflicting.

Thoughts on these lines suggested that a complete solution might be obtained by the machinery of "pooling" the net profit or surplus for division among all who had contributed to it by their work, whether manual or mental, and by their abstinence and enterprise. Under present conditions an employé had little inducement to work fully and well. The employer benefited more by good and hard work than the worker; consequently, the latter had little inducement to make efforts beyond the point necessary to keep him in his employment.

The process of "pooling" the whole of the profits presented a difficult but, he believed, not insurmountable problem of statesmanship. Broadly speaking, the profit or surplus in modern industry was the difference between the selling price and the cost of production, in which latter should be included: (*a*) wages to provide for the human needs of labour; (*b*) the cost of raw materials and all standing charges; (*c*) the replacement of renewable capital, the adequate maintenance of fixed capital, and the provision of proper reserves for contingencies; (*d*) reasonable reward for managers, inventors, designers, and brain workers generally who have taken part in the production; and (*e*) necessary interest on the capital embarked. After these items had been provided for out of the selling price or revenue, the surplus should be distributed equitably between the various contributors, manual workers, brain-workers, and capitalists in proportions to be settled for each industry, area, and undertaking.

It would require some machinery to do this, but a large bureaucracy, say a Ministry of Profits, would be better employed in framing principles to govern this distribution than by hampering production in the futile attempt to run national industries on commercial lines. The existing organisation for settling liability for income tax offered an analogy to the sort of machinery required. Such a Ministry would be subject to Parliament, and linked to the business and industry of the country by commissioners, whose functions would be to see that the correct surplus was paid into the "pool," and that claims to an equitable division of the surplus were fairly adjusted.

The management and administration of undertakings would be left to private enterprise as at present, with the lure of profit and success to make them efficient, but all those who contributed to the production of its surplus should be afforded ample opportunities of understanding the object and intricacies of the organisation, and should be represented in its control.

The underlying merit of this proposition was that we should not abolish profit, but, on the contrary, enormously increase it by adding to every man's stimulus to augment it. The scheme might look like socialism, but it was also individualism, and thus we should get not alone a balance of natural forces, but also the happy mean which was the aim of our political system, and the feature of all economic experience.

Production of wealth—though it was not the only thing for making contentment—was the paramount condition of well-being, but the world had now for the first time in history reached a point at which well-being was seen to be dependent also on the problem of how the wealth could be equitably distributed. The solution could not be found by destroying profits and eliminating capital, but it could be found, by a recognition of the first principle, that profits belonged to the producers of profit, and all that was required was the necessary machinery to ascertain who were the producers and what was their fair share in an equitable division of the product. To take the view that capitalists paying wages to the workers were entitled to the whole of the profits, ignored even the more moderate temper of the proletariat, according to which labour paying interest to the capitalist should take all the profits. The other notion that one man's profit was another's loss applied only to operations in the nature of gambling, where there was a transfer of counters, but no production of wealth.

THE BELFAST EXTENSION SCHEME.

A special meeting of the Belfast Corporation in committee was held on April 26th to consider reports from Sir John Snell and Mr. J. H. Rider on the extension scheme of the electricity works. It will be remembered that the total estimate submitted to the Local Government Board inquiry last year was £310,000, but it was recently discovered that this estimate will be greatly exceeded. It now appears that the buildings instead of £48,000 are to cost £217,000, and the cost of the plant will be £411,000. This, with £20,000 for the site, makes a total of £648,000. The lowest tender for the foundations alone was £115,000. The Corporation has entered into agreements to supply the shipyards with electricity for ten years at prices based on the original estimates, which prices cannot be varied except by variations in the price of coal. Mr. Rider attended the meeting, and gave a lengthy explanation of the revised estimates, and made suggestions for overcoming the present difficulty. The new detailed estimate which is based mainly on tenders, is: Land, £20,000; buildings, £216,960; plant, £345,000; accumulators, £4,500; cables and laying, £61,500; total, £648,590.. The great excess over the original estimate is in the cost of buildings and foundations, namely, £162,000. It is admitted that the original estimate of £48,000 was too low, and was made before plans had been prepared. As soon as preliminary plans were made (including an engine room to accommodate 25,000-kw. sets) it was evident that larger and more costly buildings would be required. Regarding the contracts with the shipyards, if the capital charges were to be taken on the former basis and on the present capital estimates, they would involve an annual loss of £16,400. It was suggested that a longer period for repayment of the loan be obtained, and new estimates were submitted, with the new capital charges based on an equated period of 30 years in place of the old figure, with interest payable at 5 per cent., and sinking fund payments spread over 30 years, and re-invested at 4½ per cent., on which basis the undertaking would be in a sound financial position with a net surplus of about £7,400 as soon as the first section of the harbour station was at work. The promotion of a Bill was recommended to authorise the payment of interest on the new capital out of capital and the suspension of the sinking fund payments during the construction period. It was also suggested that the L.G.B. be asked to grant loans for the following periods; 100 years for buildings, 60 years for foundations and river work, 25 years for plant, and 30 years for cables, or an equated period of 30 years for the whole. Consideration of the matter was adjourned.

Chemical Actions in the Lead Accumulator.—The usual equations for the chemical actions in a lead cell are not sufficient to explain the facts, says a writer in the *Bulletin* of the Société Française des Electriciens. The E.M.F. produced does not agree with the value theoretically calculated from the thermo-chemical reactions involved, and a number of physical phenomena are not explained. According to the usually accepted theory the weight of the positive and negative plates should vary to the same extent, whereas the positive plates are actually practically unaltered in weight during charge and discharge. Other circumstances, such as the changes of colour observed in the positive and negative plates, do not bear out the usually accepted theory. The researches indicated by the author tend to show that an oxide richer in oxygen than PbO_2 is present at the beginning of the discharge, and that the positive active material is not PbO_2, but Pb_2O_7 or Pb_3O_4. Regarding the negative plate, it is concluded that the negative active material does not get transformed on discharge into $PbSO_4$, but into Pb_2SO_4.

THE PROPULSION OF THE MODERN SUBMERSIBLE TORPEDO BOAT.

By Captain NORMAN H. WOOD, R.A.F.

(*Abstract of paper read before the* Institute of Marine Engineers.)

Almost without exception, modern submersibles have their main propelling machinery arranged engine-clutch-motor-clutch-propeller shaft, and to all outward appearances this procedure would appear to be perfect. In practice, however, it has been found to offer considerable drawbacks, especially in war time, due principally to the negative reciprocating action of the Diesel engine on the clutches. The only type of coupling available is the claw, and no matter how carefully the machining of the dogs may be carried out, eventually a rattling and hammering is set up which causes considerable trouble.

One of the principal requirements of an ocean-going submersible in war time is that it shall be able to dive or rise to the surface without the slightest trouble and loss of time in changing over from one prime mover to the other, or in the starting-up and stopping of the same. Under existing circumstances, after a dive, it is imperative to start up the Diesel engines by means of compressed air owing to the grave injuries that might be sustained in the event of water having leaked into the cylinders and the engines being brought up to speed by the main motors. The usual practice is to stop the electric motors, turn the engines by means of their toggle gear until the couplings can be inserted, and then turn the engine, motor, and propeller shafts through the same medium until the correct starting position for the pistons has been reached, and then to turn on the compressed air. Trouble in starting the engine may cause large quantities of compressed air to be drawn from the main storage system in a few minutes, which may take as many hours to replace.

Every practical seagoing marine engineer will appreciate the very important disadvantages of having the main propelling shaft split up into three separate lengths, each connected by a sliding dog-clutch, and the practical impossibility of maintaining these in true alignment under seagoing conditions.

The starting-up of the Diesel engines by means of compressed air has been found to present a number of serious disadvantages. Experience has shown that the cylinder heads of Diesel engines often crack after the machines have been running some time and are then stopped, and restarted with compressed air which on entry to the cylinders must (on expansion) be at a refrigerating temperature.

High speeds on the surface demand very greatly increased outputs by the prime movers. Efficient submersible type Diesel engines of 150 to 200 h.p. per cylinder have been successfully constructed, but as soon as larger units are attempted difficulties multiply rapidly. The Diesel engine increases in weight per h.p. as the size of the engine increases.

Perhaps the greatest disadvantage of the modern type submersible is the fact that the rate at which the battery can be charged is practically in direct ratio to the speed of the prime movers and thereby the speed of the vessel. The great war has proved that the underwater craft are only dangerous when submerged, and, on the other hand, that a submersible's only chance of escaping from high-speed surface craft lies in being able to submerge quickly and for a long period. On rising to the surface again there are times when all possible speed must be crammed on in an endeavour to escape, but after night-fall it may be found advisable to cruise slowly about and at the same time charge the battery in the least possible space of time. Two courses are open to the commander: (*a*) to travel at a good speed, and thus revolve the dynamos at high speed; (*b*) to uncouple the propeller shaft and utilise the full power of the engines to charge the battery. The first procedure entails the unnecessary consumption of oil fuel and thereby lowers the cruising radius of the vessel; the second places the vessel at the mercy of enemy underwater craft.

A short summary of the disadvantages claimed for the present system of propulsion is: the couplings; difficulties experienced in starting up the Diesel engines and the dangers entailed by using compressed air to effct this purpose; the possible uncertainty of messages transmitted through the voice pipe or engine room telegraph being correctly given or received when reliance is placed on the human element; the necessity of carrying large quantities of compressed air; the probable loss of the vessel in war time should one of the prime movers break down hopelessly on the high seas; and lastly, the almost impossibility of charging the battery quickly when the vessel is proceeding slowly on the surface.

To eliminate entirely these disadvantages the "Wood" system of propulsion has been projected. With this system a submersible would be fitted with high-speed prime movers directly coupled to light-weight electric generating sets and electrically coupled to low-speed, light-weight electric motors directly coupled to the propeller shafts, making use of the electrical elements to effect a reduction in speed without resorting to gear boxes, &c. With this arrangement the greatest possible efficiency in every way is achieved so far as the marine propeller is concerned, and the manœuvring capabilities of a submersible thus equipped are increased enormously. As the propeller shafts are directly coupled to the main propelling motors loose couplings are entirely eliminated. The vessel can be driven "ahead" or "astern" at full speed or any other speed by controlling the main propelling motors without interfering with the speed or direction of rotation of the prime movers. It is possible therefore to fit high-class reliable governors to the engines driving the dynamos. In the event of the propellers coming out of the water racing does not occur, and the cruising radius of a submersible thus equipped is considerably increased.

The fuel consumption of the internal-combustion engine increases very quickly if the load is taken off, but in the "Wood" system each prime mover is kept always as fully loaded as possible, and the r.p.m. constant. At very low speed the current consumption of the main propelling motors will be so calculated as to ensure one of the prime movers being fully loaded. At half speed the current consumption will ensure two generating sets being fully loaded, and so on until full speed is reached, when all the generating sets will be in commission. It is, however, only on rare occasions that full speed is necessary; the ordinary cruising speed is about three-quarters full speed, so that one or more generating sets are always available to charge the battery up or act as "stand-bys." The great drawback of the battery charging rate being in direct ratio to the r.p.m. of the propelling machinery is entirely eliminated by this system, as one generating set can be utilised to supply the main motors and all other sets can be placed on the battery charging load. The great elasticity of the system is further proved by the fact that should the vessel be travelling at its lowest speed, and only one generating set be on load, and this break down, no alteration or diminution in the vessel's speed would be possible as the battery would at once pick up the load and carry on until one of the other generating sets could be brought up to speed and switched on to the main busbars. Should engine trouble develop, little damage would be sustained, as the dynamo would motor at practically the same speed in the same direction, and the failure of the set to supply current would immediately be recorded by the ammeter. Should the dynamo break down, the fuses would blow, isolating the set, and the governor would prevent the engine from racing, and here again the ammeter would show that something was wrong. In the event of ordinary internal-combustion engines being installed as prime movers, any delays in starting up would offer very few, if any, disadvantages as the vessel could be driven by the battery until the engines could be brought up to speed and made to take over the load. It would still be necessary, after a dive, to start up the engines pneumatically, but starting is simplified enormously owing to the no-load conditions. As the motors and generators are separate units, the distribution of the whole plant is rendered much more elastic in every way. To save weight it is advisable to reduce the lengths of the propeller shafts to the utmost, which procedure demands that the main motors shall be placed as far aft as possible, but the generating sets can be distributed about the vessel at will and thereby prevent the whole submersible from becoming inoperative, as is the case under existing conditions if the engine room is flooded. The greatest danger lies in the main motor compartment being damaged by shell fire or other such cause, and springing a leak. This eventuality is minimised to a great extent by the fact that the after portion of the watertight pressure hull in a submersible is always well below the water line, even when travelling on the surface, so that the chance of such a trouble occurring can be accepted as a legitimate war risk.

To reduce their diameters and to facilitate starting and speed regulation, the main motors would be split up into two units, each capable of delivering half the total output required for each propeller shaft. The same methods of construction would be applied to the generators, to ensure the base plates and diameters of the yokes not being greater than the width of their respective engines, and thus allow of the complete sets being efficient so far as stowing space was concerned. The "Wood" system enables greater speeds with increased displacements to be achieved, as an increase in the total output merely demands an increase in the number of main propelling motors attached to each propeller shaft, and a corresponding increase in the number of generating sets.

In all cases the main control switch-gears would be placed as close to their respective units as possible, to reduce to a minimum the lengths of heavy cable necessary to effect control. Automatically operated switchgear would be made use of, however, with the operating auxiliary controllers placed adjacent to the conning tower and periscopes and so arranged that they could be worked from the bridge, conning tower, or inboard steering position, and thus enable perfect control of the whole propelling machinery to be undertaken by the

officer on watch without the necessity of resorting to voice pipes, bells, telegraphs, or telephones. Instructions would be issued to the engine-room staffs to open the valves controlling the prime-mover exhaust boxes after each dive as soon as the vessel was completely on the surface, and to start up each engine pneumatically and allow it to run on no load for a few seconds, and then shut it down. This method of procedure would ensure that any water that had leaked into the engines whilst the vessel was submerged would be blown overboard, and thus enable the engines to be started up by the officer on watch at any moment by switching the dynamos on to the main busbars and causing them to motor until the engines could pick up and carry on. The current for the first set started up thus would be taken from the battery.

Should the vessel be proceeding at slow speed on the surface and a crash dive become necessary, the officer on watch on the bridge would immediately ring the diving gongs to summon the members of the crew to their diving stations, and then quickly take each generating set off load by means of the automatic control gear before leaving the bridge. He would then descend through the conning tower into the inboard steering position, and take over the control of the vessel from this position. But no stopping of the propellers or starting-up of the main motors as at present would find place in the programme, because as soon as the generating sets were shut down the battery would pick up the load, and the vessel would proceed at the same speed.

A submersible fitted with the "Wood" system of propulsion would therefore be able to dive very much quicker than theretofore, because as soon as the diving gongs rang the coxwain and his mate would immediately operate the diving rudders to cause the vessel to slip under water, without waiting for instructions from the engine room to the effect that the engines had been stopped, their couplings undone, and the main motors started up, &c.

This system would, of course, entail a great deal more work on the part of the vessel's commanding officer, but at the same time relieve his anxiety and trouble during a crash dive, as the engine-room staff would not be tumbling over each other to carry out their duties as under existing conditions.

As an example, it is assumed that the power required to drive a submersible displacing 1,200 tons on the surface at 18 knots = 2,400 B.H.P. To comply with the requirements of the "Wood" system four high-speed generating sets, each capable of delivering 590 KW. at 220 to 300 volts with 750 R.P.M. continuously, would be installed in conjunction with two electric motors, each capable of delivering 1,200 B.H.P. at 220 to 300 volts with 50 to 200 R.P.M. continuously, together with two electric storage batteries of 120 cells each, coupled in parallel, with the following total outputs.

8,000 ampere-hours at the 1 hour rate of discharge.
11,650 ampere-hours at the 3 hour rate of discharge.
15,100 ampere-hours at the 10 hour rate of discharge.

This battery would have a sufficiently large output to drive the vessel at very nearly full speed for roughly an hour or lesser speeds for greatly increased times before the voltage of each cell fell below 1.8 volts.

Each of the main propelling motors would be split up into two separate units of the shunt-wound open type, fitted with compensated windings and commutating poles. Series-parallel speed regulation would be used.

The dynamos would be of the same construction as the motors, but with the armature windings always coupled in series.

To permit all the controlling switchgears to be automatically operated from the centre control position, in the "Wood" system, ordinary quick-break knife-type switchgear would be installed, but the individual switches would be caused to cut in and out very quickly by means of small gear wheels and clutches operated by small high-speed series-wound electric motors with flywheel attachments to gather up inertia and discharge the same where needed whilst working the gears. The starting of these motors would be effected by means of the master hand-operated controllers in the centre control position, and stopping by the action of small limit switches attached to each switchgear.

To increase the efficiency and to decrease the slip and thereby the cavitation of the propellers the submersible will further be fitted with the "Birkett Regenerative Stator" propellers, which ensure an increase in speed of from 5 to 10 per cent. in the case where the existing propeller is used, and from 10 to 15 per cent. in the case where a new propeller, designed to operate with the stator propeller, is fitted, without in any way increasing the normal output and revolutions of the prime mover.

After considerable study and research work to find a suitable prime mover for the "Wood" submersible, the conclusion has been arrived at that an interesting type of engine, the invention of Capt. Wm. P. Durtnall, embodies not one, but many features which are highly desirable and significant.

In adopting the "Paragon" cycle for submersible prime movers, the fact has been taken into consideration that a very considerable increase in the travelling radius at various speeds is possible, owing to the high thermal efficiency of Capt. Durtnall's double-acting engines. The six-cylinder design is capable of developing 750 B.H.P. at 750 R.P.M. It operates on the 4-cycle principle, and is fitted with light-weight pistons of ordinary steam engine design (but cooled by means of pure water circulation) and crossheads.

The engines are further fitted with balanced-piston-type valves, a feature that is possible owing to the better general heat conditions under which these engines will operate. As the valves are "pulled" instead of being "pushed" off their seatings their duty is considerably lightened, especially when it is borne in mind that the expansion is taken down to about 3 lb. above the pressure of the atmosphere before the exhaust valve opens.

A very important feature in this design of engine is the fact that being of the "double-acting" type, the cylinders are entirely sealed up, and no burnt or other gases can possibly be liberated into the engine room. For a given power and speed the height is less than the "single-acting" type, the moving parts are lighter, the momentum and inertia losses are consequently smaller, the bearing surfaces are reduced with safety, the turning moment is extremely even (in fact almost as good as a turbine), and consequently no fly-wheel is required. Each engine is estimated not to exceed about 10.45 lb. per H.P.

In the "Wood" submersible these engines would be started electrically by the dynamo being made to run as motor from the battery; the ordinary atmospheric air being used and compressed to about 300 lb. per square inch, the maximum pressure the cylinders will have to stand. Bearing in mind that the explosion pressure of the "Otto" cycle type of engine reaches this pressure and the cylinders have to be designed to withstand this, the "Paragon" engine need not be constructed to weigh more than the ordinary "Otto" type engine installed in the earlier type submersibles. This very important feature, combined with the fact that the necessity for a flywheel has been entirely eliminated, ensures the production of a light weight, simple, reliable, and efficient type of prime mover, automatic in action, and yet combining the maximum of output with the minimum of weight and stowage space.

These engines will operate on gas made at about 400 lb. pressure from a special liquid fuel prepared from coal or crude residue oil, in oil-gas producers, very small in size, yet possessing high thermal efficiency with the minimum of weight.

INSULATION FOR INSTRUMENT TRANSFORMERS.

MR. C. SARKAR, electrical engineer, of Jamshedpur, India, has sent us the following particulars of a method which he has devised for improving the insulation of high-pressure instrument transformers, with particular reference to the attainment of reliability and safety in this admittedly weak link in the chain of connections:—

Hitherto it has been customary to insulate the high-pressure coils of instrument transformers by wrapping round them empire cloth, rubber tape, or the like, but this method is not sound and reliable; it is impossible to get uniform wrapping all round the coil and its corners under manufacturing conditions. It is quite possible to find six layers in one place

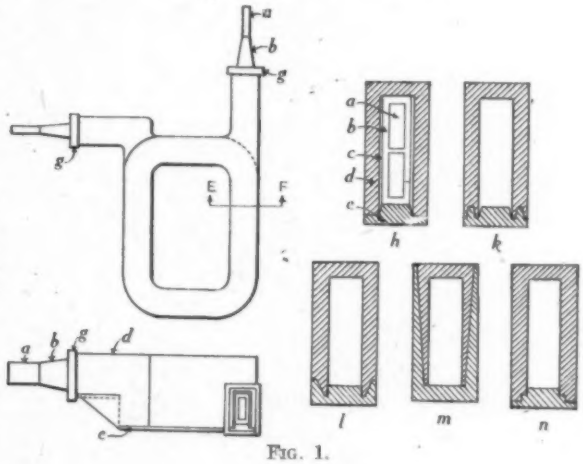


FIG. 1.

and three layers in another. It is also impossible to determine by inspection whether a coil has been insulated with three or four layers of insulating material. Empire cloth insulation may stand a high-voltage test for a short time, but the strain of the high voltage may injure the insulation, and it may give way afterwards. The designing engineer has no reliable figures to calculate the insulation, but has generally to depend on an empirical rule. The accuracy of the instrument transformer depends to a large extent upon putting the primary, secondary, and core close together, but we cannot employ a large factor of safety without increasing the distance between

these parts; this will increase the inaccuracy of the measuring instruments and decrease the sensitiveness of the protective gear. There is also great difficulty in bringing out the two ends of the primary winding. The instrument transformer is the weakest point in the whole of the switchgear; except the generator itself there is no weaker point in the whole circuit. Hence it is very desirable to have a more reliable and accurate instrument transformer. Compound or oil immersion does not improve the insulation between primary, secondary, and core to any great extent.

A better plan is to have a trough or housing made of porcelain, bakelite or similar hard insulating material. In this trough the high-pressure coil, which is insulated with empire cloth for ordinary voltage, is completely enclosed. The trough may be of any convenient shape to suit the form of the coil. It may, for example, consist of a hollow central body having at two points tubular branches, the body being adapted to receive the lightly-insulated finished coil, and the branches the terminal leads thereof; a similarly shaped lid or cover is put over the trough, thus completely covering the coil. Two rings can then be slipped over the ends to keep the trough and its lid in position, and in addition it may be bound with string at different places.

In fig. 1 is shown the completely insulated high-pressure coil of a current transformer in a trough; *a* is the copper strip terminal, *b* is a wrapping of empire cloth, *d* is the trough made in one piece, and *e* is the lid, *g* is the ring made of insulating material to keep the trough and lid in position.

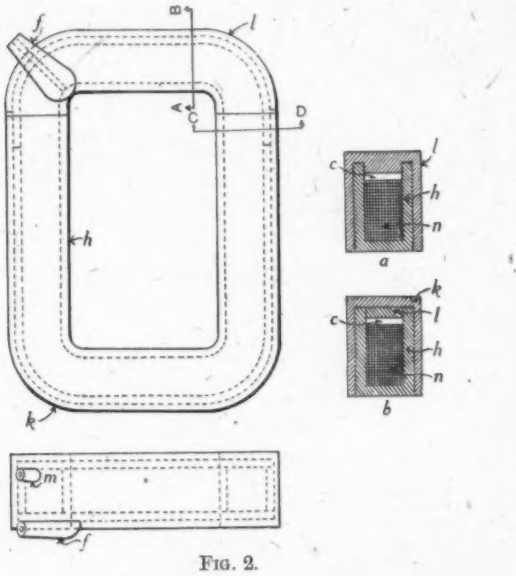


FIG. 2.

Fig. 1 *h* shows the section through the trough at EF; the letters have the same significance, and *c* is insulating compound.

Fig. 1, *k*, *l*, *m*, *n*, also show sections through EF for different designs of trough and lid, arranged to increase the creeping surface in the joint to suit the voltage.

This completely insulated high-pressure coil in its trough can be built up, with iron stampings and the low-pressure coil into a current transformer.

According to another design, when using the said trough or housing for a thin cotton- or silk-covered wire or for a shunt transformer, the trough is made in the form of a bobbin of porcelain, or other hard insulating material, and the wire is wound straight into the said bobbin, with the usual paper insulation between the layers. The end of the bottom layer should be brought out through the knob or terminal of suitable shape as shown at *f*, fig. 2, thus leaving no chance of breakage of the lead. The bobbin, with the coil in place, can be impregnated with insulation in vacuum, as usual; then two lids or covers are put on (one at the bottom and the other at the top, with a knob to bring the top end of the coil out) after pouring hot insulating compound over the bobbin, so that the compound will fill the joints between the bobbin and its lids; thus making a solid job without leaving an air-space anywhere. The bottom lid overlaps the top lid for some distance at their joint, thus completely covering the coil. String binders may be used at different places to keep the bobbin and its lids in position. Different designs of bobbins and lids may be used as shown in the case of the current transformer, increasing the length of the creeping surface through the joint, to suit the voltage.

In fig. 2 is shown the completely insulated high-pressure coil of a shunt transformer.

Fig. 2 *a* shows a section through the coil and bobbin at AB, and fig. 2 *b* shows a similar section at CD.

In fig. 2 *f* is the knob or terminal to bring the bottom end of the coil out, and is made in one piece with the bobbin *h*; *m* is the knob to bring the top end of the coil out, and is made in one piece with the top lid *l*; *l* is the top lid or cover with knob *m*, and is arranged to be overlapped by the bottom lid *k*, as shown; *n* is the high-pressure coil of cotton-covered wire with the usual insulation between the layers; *c* is insulating compound.

The above method of insulation may be easily adapted to electric circuit protective gear, both for current and pressure coils. The same size of trough may be used for instrument transformers of different capacities as the ampere-turns of the different transformers are approximately the same.

WIRELESS DIRECTION-FINDING APPARATUS.

AN interesting article is contributed by Capt. A. S. Blatterman, U.S.A. Signal Corps, to the *Electrical World*, on the uses of wireless direction-finding apparatus. A listening station may intercept enemy communications, and determine by measurements their origin. This is known as goniometry. Again, a flying machine may determine by wireless measurements the direction of fixed ground transmitting stations, and thereby the pilot is able to navigate his ship in a manner analogous to methods involving the readings of a magnetic compass.

The loop, as commonly used for directional receiving, consists of a vertical closed coil of several turns of wire which can be tuned to incoming waves by means of a variable condenser connected across its terminals. A detector is connected either directly or

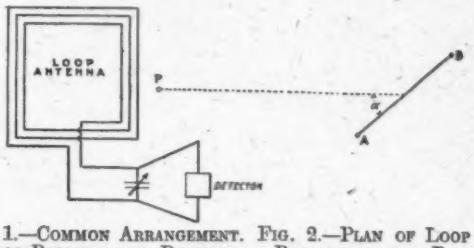


FIG. 1.—COMMON ARRANGEMENT. FIG. 2.—PLAN OF LOOP OF LOOP RECEIVER AND DETECTOR. RECEIVING FROM P.

inductively to the oscillating circuit so formed, the most common arrangement being that shown in fig. 1. Such a system, when properly designed and used in connection with a sensitive multi-stage vacuum-tube amplifier detector device, may be effectively employed for receiving wireless signals over very long distances. For instance, it is easily possible to hear the high-power stations of Europe in America by using a loop frame 5 ft. or 6 ft. (1·5 m. or 1·8 m.) square with 20 or 30 turns of wire on it.

The use of this type of antenna as an apparatus for locating the direction of a transmitting station depends on the fact that a vertically placed coil such as that described receives electro-magnetic wave energy best when its plane coincides with the

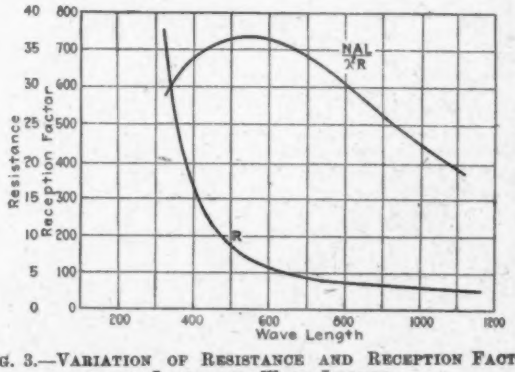


FIG. 3.—VARIATION OF RESISTANCE AND RECEPTION FACTOR OF LOOP WITH WAVE LENGTH.

direction from which the waves are arriving, and practically not at all when placed at right angles to the direction of wave travel. Thus, in the practical use of the apparatus it is only necessary to be able to orient the loop about a vertical axis, noting the strength of signals at different settings, in order to locate the direction of the source of any wireless message that may be picked up. If two receivers equipped with this kind of apparatus are set up a known distance apart and both determine from their respective locations the direction of a certain transmitting station with respect to the geographic north and south meridian, it becomes a simple matter of triangulation on the known base line joining the receivers to fix definitely the exact position of the transmitter.

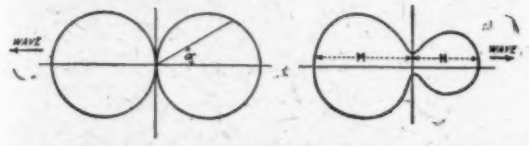
In order to get the best results from the loop receiver it is necessary to proportion the size of loop properly, the number of turns, their spacing, the size and kind of wire, &c., to the wave lengths to be employed. Charts have been worked out from which

it is possible to design these coils quickly for any desired wave length, so as to get maximum receiving efficiency.

The effective value of E.M.F. induced in a loop of N turns and threaded by a harmonic flux ϕ, such as produced by sustained oscillations in a distant radio antenna, $E = \sqrt{2}\,\pi f N A H$, where f = frequency, A = area enclosed by loop, H = field intensity.

If the loop is tuned to the frequency of the field in which it is placed by means of a condenser across its terminals, the impedance of the circuit so formed becomes equal to the resistance of the circuit, and the R.M.S. current flowing will be $I = \sqrt{2}\,f N A H \pi / R$.

This current produces a voltage across the tuning condenser, which is used to actuate the detector of the radio receiving set



Figs. 4 and 5.—Theoretical and Actual Directional Characteristic of Loop Obtained in Practice.

(fig. 1). The value of this voltage is given by the expression $E_c = k N A L/\lambda^2 R$, where k = a constant, L = inductance of loop, λ = wave length, R = effective resistance of loop circuit.

It is found that none of the factors N, A, L or λ can be varied without affecting the value of R, and most important of all is the very marked effect of changing wave length on the effective resistance. In fact, this circumstance gives rise to the existence of a critical optimum wave length for any given loop at which signals have their maximum strength, as indicated in fig. 3.

As has been stated above, the loop antenna has very pronounced directional characteristics. If A B (fig. 2) represents the plan view of the loop, which is receiving waves sent out from P, the flux threading the loop is proportional to $\cos \alpha$. Hence the received current will vary for different angular displacements in a manner which can be represented by a polar curve characteristic, consisting of two tangent circles (fig. 4). This would indicate that when the plane of the loop is at right angles to the direction of propagation no energy will be received, while strongest signals will occur when the plane of the loop coincides with the direction of wave travel. For direction finding the loop would be oriented until no sound was heard in the receiving telephones. In practice, conclusions based on the general theory must be somewhat modified.

In general, the polar curves are not circles, but are changed according to the shape and dimensions of the loop, the manner of winding, proximity to the earth's surface or near-by conductors, the nature of the ground, and the arrangement and disposition of the receiving apparatus. Thus a typical characteristic obtained by measurement of received signal at different angular positions of the loop is similar to that shown in fig. 5. The two maxima and the two minima are unequal, and the curve is distorted. Investigation of this distortion effect led to the development of methods for controlling it, either increasing it principally to augment the asymmetry of the maxima, and thus secure a device which would indicate not only the line of the transmitting station, but its sense or absolute direction, or else decreasing the disaymmetry in such a way that a very sharp minimum is secured, thus gaining directional accuracy.

There are several ways of increasing the sharpness and symmetry of the minima of the polar curve. The solenoidal type of winding is better in this respect than the flat pancake loop. A small condenser C (fig. 6), by means of which the capacity to earth of the two loop terminals may be equalised is helpful. Another method is to use an electrostatic shield, consisting of a harp of parallel wires placed horizontally just above the loop, and earthed (fig. 7).

Flat pancake loops, with unequal maxima and minima, have been used for finding absolute direction, since, after finding the line by means of right-angle settings, it is only necessary to swing the loop into the position for maximum signals, and compare the strengths M and N (fig. 5), by reversing the loop 180°, or by interchanging the condenser connections. When a loop is placed with its winding plane parallel to earth it becomes non-directional, and receives signals equally well from all directions. This arrangement is therefore valuable for intercept work.

The accuracy of the direction finder, and the speed with which settings can be made, depend on the sharpness of the minimum points in the directional polar characteristic. If the sensitiveness is great, it is often difficult to find an absolute zero as the loop is rotated. Nevertheless, it is generally desirable to have the direction sensitiveness as great as possible, for the following reasons. If the polar curve is as shown in fig. 8, and the sensitiveness of the detecting apparatus is such that it just responds to potentials of value V_1 and voltages less than this cannot be detected, then as the loop is rotated zero response will be obtained throughout the regions A B and C D. If, however, the detector sensitiveness is greater, so that smaller voltages down to the value V_2 can be detected, the zero regions are narrowed down to A′ B′ and C′ D′, and the apparatus becomes more accurate. By further increasing the sensitiveness still greater accuracy is obtained as the zero regions are further narrowed, and, in the case shown, an increase in sensitiveness to correspond to the potenial V_0 would give a single point or position where there would be zero response.

It is very desirable to produce this condition, but to do so requires extremely sensitive detecting apparatus as well as a very sharp antenna (loop) characteristic. If the zero regions are wider than a few degrees, so that they cannot be accurately and quickly bisected experimentally, the average of the four readings A, B, C, D, where the signal becomes inaudible, must be taken as an indication of the true minimum. This requires time. It has, however, been found to give good accuracy provided the regions of silence do not exceed about 30°.

With the uncompensated loop the mid-points of the regions A B and C D are not 180° apart, which makes it necessary to average all four readings as just described. The electrostatic shield effectively removes this dissymmetry.

In working out a small portable outfit for field use the size was limited to 5 ft. (1·5 m.) on a side in order to meet the requirement of portability. The stipulated wave-length range was 300 m. to 800 m. Extreme directional sensitiveness was required, together with the highest efficiency obtainable, in order to permit setting up as far as possible back from the battle front and shelled area.

The equipment furnished comprises a vertical collapsible loop surmounted by an electrostatic shield consisting of a harp of wires 5 ft. long by 2 ft. wide (1·5 m. by 0·6 m.). The loop itself contains five turns of No. 18 wire sewed in a canvas strip. A collapsible table, measuring 5 ft. by 3 ft. (1·5 m. by 0·9 m.) on top and approximately 30 in. (0·75 m.) high, is furnished and supports the loop and its shield. Electrical connections to the loop are permanently made with the necessary lead wires fastened to the table top. A wheel with shaft and gear arrangement is provided and permanently fixed to the table for rotating the loop, and the whole structure folds together, forming a comparatively flat package for transit. A multi-stage combination radio-frequency and audio-frequency amplifier is used.

The coupling between both the frequency stages is provided by iron-core transformers whose impedances are adjusted to match the internal output tube impedance and whose turn ratios are approximately one to ten.

The requirements for aeroplane use are rather different from those for use on the ground. In an aeroplane the noise of the engine and rush of air drown out all save the very strongest signals, and the ordinary direction-finder methods are therefore of no use at all. Setting must be made "on the signal" rather than on the zero. This involves the use of a new method, credit for the application

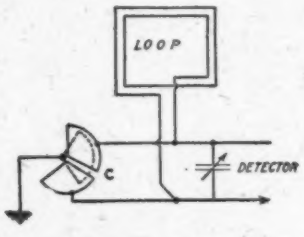


Fig. 6.—Condenser Compensator for Improving Directional Accuracy.

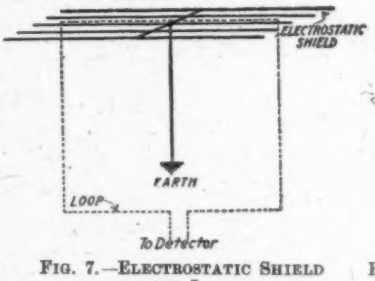


Fig. 7.—Electrostatic Shield above Loop.

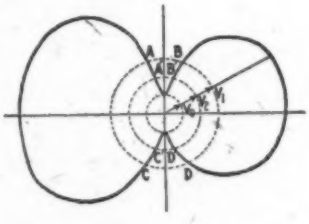


Fig. 8.—Effect of Detector Sensitiveness on Directional Accuracy.

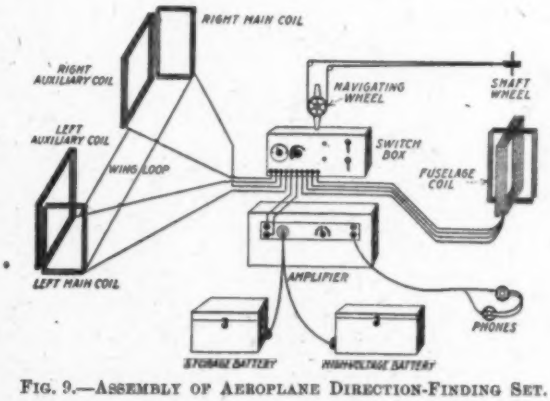


Fig. 9.—Assembly of Aeroplane Direction-Finding Set.

of which is due to the British. The method used allows of setting to the required direction with maximum strength of signal, while, at the same time, it retains the directional sensitiveness.

Two distinct sets of loops are provided. One is mounted rigidly on the struts and wings of the plane, a main coil fore and aft and an auxiliary coil athwart-ships. These coils have their turns sewed into a canvas band or strip about 6 in. (15 cm.) wide, which is cemented on to the struts and the entering edges of the planes. They are used for straight homing flying. Another smaller set, about 3 ft. (0·9 m.) square, is mounted inside the fuselage of the aeroplane and arranged so that it can be rotated about a vertical axis by the navigator by means of a disk, cords, and pulley device. By means of this second set of coils and a graduated dial the line of one of the beacon stations can be set, and if two such readings are taken quickly on different beacon stations the location of the plane may be determined. When the fixed wing coils are used it is necessary to alter the course of the ship in order to make the direction setting. The accuracy obtainable is about plus or minus 1° in making the setting. The general arrangement of the apparatus is shown in fig. 9.

The principles worked out relating to this type of apparatus and the methods evolved for their application will, without doubt, find application in the near future to numerous fields. Already ships at sea have been equipped with directional apparatus, and the Post Office Department at Washington has now begun investigating the question of using direction-finding compasses on planes in the aerial mail service.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,934. "Switches for electric lamps." Clifford Bros. & J. Riddell. April 22nd.

9,966. "Magneto-electric machines for engines ignition." A. Sheppard. April 22nd.

9,967. "Electric generators and motors for working under water, &c." C. H. Hall. April 22nd.

10,018. "Electric lighting systems." D. E. Westcott. April 22nd.

10,020. "Ignition magneto advance and retard gear." S. O. Crossley. April 22nd.

10,038. "Spark-plug indicators." C. F. Pinneo. April 22nd.

10,042. "Connectors for electrical conductors." J. de Frece. April 22nd.

10,045. "Commutators for dynamo-electric machines." H. Chitty. April 22nd.

10,048. "Electric switches." R. Norton. April 22nd.

10,053. "Polyphase electric heating furnace." E. C. R. Marks (Armour Fertiliser Works, U.S.A.). April 22nd.

10,063. "Current-connecting devices for dynamo-electric machines." A. A. Pollock & W. H. Scott. April 22nd.

10,065. "Sparking plug." W. G. Clayton. April 22nd.

10,066. "Battery cells." P. D. Ivey & A. J. Salisbury. April 22nd.

10,067. "Battery cell hydrometers." P. D. Ivey & A. J. Salisbury. April 22nd.

10,096. "Regenerative braking system for electrically-driven vehicles." K. H. O. Lubeck. April 22nd. (Sweden, April 20th, 1918.)

10,116. "Electrolytic cells." C. W. Marsh. April 23rd.

10,128. "Contact-breakers for magnetos." G. G. Dawson. April 23rd.

10,130. "Electric furnaces." A. M. Texeira. April 23rd.

10,155. "Process of electrolysis." N. H. M. Dekker. April 23rd.

10,158. "Electrical connector for engine sparking plugs, &c." V. Bardin. April 23rd. (France, January 16th.)

10,159. "Sparking plugs." V. Bardin. April 23rd. (France, February 4th.)

10,179. "Apparatus for electrolysing liquids." J. S. Withers (National Electro-Products, Ltd., U.S.A.). April 23rd.

10,193. "Carbon-holder and feeding mechanism for arc lamps for kinematograph projectors, &c." A. W. Newland. April 23rd.

10,197/10,198. "Machines for making bobbins for electric batteries." National Carbon Co. April 23rd. (U.S.A., January 10th, 1918.)

10,202. "Automatic telephone system." T. Lenaghan. April 24th.

10,209. "Automatic time-switch for electric lighting, &c." M. Volk. April 24th.

10,214. "Automatically-controlled make-and-break for internal-combustion engines." H. Duran. April 24th.

10,217. "Reducing lagging current on alternating-current systems supplying induction motors, &c." H. A. L. Barry. April 24th.

10,219. "Sparking plugs." H. Singleton-Griesbach. April 24th.

10,220. "Means for ventilating dynamo-electric machines." Brolt, Ltd. April 24th.

10,241. "Incandescent electric lamps." J. Bilefeld. April 24th.

10,268. "Galvanic batteries." G. Oldham & J. Oldham. April 24th.

10,273. "Automatic apparatus driven by electric motor for winding spring-driven clocks." H. Ramseyer, F. Guye & L. H. Borel. April 24th.

10,306. "Friction contact ratchet mechanism." T. Quick. April 25th.

10,314. "Electrolytic process for coating iron or steel with lead or antimony or alloy of lead and antimony." C. Bowen & Q. Marino. April 25th.

10,336. "High-tension magnetos." J. H. Runbaken. April 25th.

10,344. "High-voltage current-distributing apparatus for electric ignition apparatus of internal-combustion engines." Scintilla. April 25th. (Switzerland, September 18th, 1918.)

10,357. "Control of power absorbed in electric furnace." W. S. Gifford, Campbell, Gifford & Waite, and D. F. Campbell. April 25th.

10,378. "Electric contrivance for greeting persons in the dark." L. Canard. April 26th.

10,390. "Electric conduit tubes and fittings." M. J. Railing & T. Taylor. April 26th.

10,393. "Device for demonstrating difference between true pole and magnetic pole, &c." E. K. Brown. April 26th.

10,413. "Electric flashlamps for photographic, &c., purposes." H. M. Batten. April 26th.

10,414. "Electrically-operated camera shutters." H. M. Batten. April 26th.

10,418. "Protective gear for turbo-alternators." British Thomson-Houston Co. & H. W. Walker. April 26th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

3,543. Apparatus for recording and reproducing sounds and electric signals. E. Russell Clarke. March 9th, 1916. (124,764.)

3,769. Electric indicators and like apparatus. J. G. Hooper & F. R. Hobley. March 14th, 1916. (124,766.)

4,295. Inductances for wireless telegraphy and allied uses and the manufacture thereof. E. Russell Clarke. March 23rd, 1916. (124,776.)

4,518. Receiving instruments for wireless signalling. A. Artom. March 27th, 1916. (124,786.)

5,331. Sound transmission by light rays actuating photo-electric cells. W. H. Bragg & A. O. Rankine. April 11th, 1916. (124,805.)

5,631. Sound detecting systems and apparatus therefor. H. R. Wilding and R. F. Bossini. April 17th, 1916. (314,812.)

5,634. Sound detectors or transmitters. H. R. Wilding & R. F. Bossini. April 17th, 1916. (124,814.)

6,056. Submarine sound signalling apparatus. S. M. Davison. April 27th, 1916. (124,825.)

6,256. Aerial conductors for wireless signalling and other purposes. J. Hettinger. May 2nd, 1916. (124,833.)

1917.

1,929. Dynamo-electric machines for use with internal-combustion engines and vehicles propelled thereby. Biljur Motor Lighting Co. April 30th, 1917. (115,414.)

1918.

1,773. Variable-speed dynamo-electric machines. Fuller Accumulator Co. and A. P. Welch. July 31st, 1918. (124,855.)

4,680. Ignition systems for internal-combustion engines. C. F. Kettering. August 30th, 1915. (Divided application on 6,406/16.) (115,812.)

5,585. Portable stand for electric lamps. W. J. Furse & Co. & H. J. Furse. April 2nd, 1918. (124,874.)

5,779. Lanterns for gas-filled electric lamps. British Thomson-Houston Co. & H. C. Wheat. April 4th, 1918. (124,889.)

6,090. Automatic electric cut-outs. A. Fernandez. April 10th, 1918. (124,906.)

6,698. Electrically-driven hoists. Veritys, Ltd., & A. Lanz. April 20th, 1918. (124,922.)

16,408. Apparatus for the attachment of electric wires to terminals. H. Windibank. October 9th, 1918. (125,014.)

16,995. Electric ignition apparatus for internal-combustion engines. G. E. Turnbull. April 17th, 1918. (Divided application on 13,318/17.) (125,022.)

18,396. Methods of and apparatus for electrical welding. T. E. Murray. November 5th, 1917. (120,906.)

20,899. Truck-type electric switchboards. Johnson & Phillips & W. A. Walker. December 14th, 1918. (125,042.)

1919.

2,644. Electrical phase converting systems. British Westinghouse Electric & Manufacturing Co. March 13th, 1918. (124,190.)

The Electric Welding of Ships.—At a meeting of the Liverpool Engineering Society on April 16th, a paper on "Some Aspects and Developments of Mercantile Shipbuilding under War Conditions" was read by Prof. T. B. Abell, R.C.N.C., ret., M.I.N.A., in the course of which the author dealt with the subject of electric welding, on which he had been called upon to report. He said that the ultimate aim must be to secure butt joints of all plating, whatever the direction of the joint; first, because that joint appeared from tests to be the most efficient when good workmanship could be assured; secondly, because weight was thereby saved, and also because in a lap joint, where great pressure could not be exerted to bring the two plates together, corrosion of a serious character was likely to result. At present, butt joints on the flat or in a vertical plane could be made without difficulty if a metal backing strip of thin material forming a strap to the joint were provided on which the weld might be built up. The horizontal butt joint between two vertical plates—the joint which would result in the greatest saving of riveting and weight—was very difficult to make satisfactorily. The difficulty was great, and would not be overcome until much further experience in the construction of large structures had been obtained. The butt weld was more efficient though more expensive, partly on account of the extra metal required in the weld.

Attention, too, was required in arranging material properly, particularly in bringing the various parts into contact, as in lap joints or faying surfaces, or into proximity for welding, and in arranging the spacing of seams to allow for contraction of the weld on cooling. This was particularly the case with butt welding, and perhaps it would be found, ultimately, that the elimination of severe cooling stresses would render butt jointing throughout quite practicable.

The angle bar attachment, so expensive in weight, was still necessary for bringing plates in planes at right angles into correct position, though here again endeavour must be made to reduce the use of the angle bar as much as possible, particularly in watertight work, where it was necessary to use four lines of welding—two continuous and two tack welds—to secure watertightness and strength. The principal difficulty in reaching this ideal lay in the fact that erection of the structure must be always very much in advance of the jointing of the parts by welding, so that angle bars would always be very much used. There was, however, no reason why angle-iron lugs should not be made to suffice.

Whether the slag-covered electrode or the bare electrode, or that protected by a volatile covering, would prove the most suitable for ship work, was still unsettled. But it would seem that efforts must be continually directed to discovering an electrode which would avoid the use of a slag covering without sacrificing the high quality in the material of the weld. Inspection would always be difficult and would require to be very close.